BETT TTEB

Retail Stores: Energy Consumption and Potential Savings

A RESEARCH REPORT

Retail Stores: Energy Consumption and Potential Savings

A RESEARCH REPORT

Sponsored by the
Energy Conservation and Oil Substitution Branch
Energy, Mines and Resources Canada

Prepared by
COGESULT,
Montreal, Quebec, and
ENGINEERING INTERFACE LTD.,
Willowdale, Ontario
under a sub-contract from
The Centre for Building Studies
Concordia University

August 1983

BETT Publication No. 83.01

The Buildings Energy Technology Transfer Program (BETT) of EMR has been created to assist building owners, users and practitioners active in the design, construction and operation of buildings in identifying technical obstacles to energy conservation. Through a nationwide network of research agencies and private sector consultants, BETT carries out research and development projects and provides the audiences mentioned above with technical reports, how-to manuals, training manuals, audio-visual aids and data bases to help them overcome these obstacles.

For further information on the BETT program please contact:

The Buildings Energy Technology
Transfer Program
460 O'Connor Street
Ottawa, Ontario
K1S 5H3

This report was sponsored under the BETT program of the Department of Energy, Mines and Resources Canada. As with all documents in the research and development report series, this report has been reproduced without substantial amendment or revision, as received from the contractor in fulfillment of task requirements. The report is distributed for informational purposes only and does not necessarily reflect the views of the Government of Canada nor constitute an endorsement of any commercial product or person.

Neither Canada nor its ministers, officers, employees or agents makes any warranty in respect of this report or assumes any liability arising out of this report.

© Her Majesty in right of Canada, 1984.

Cat. No. M91-3/83-01E
ISBN 0-662-12828-1

ABSTRACT / RESUME

Many Canadian retail chains have already begun to implement low cost energy conservation measures. With these measures alone, the potential for conservation for the entire retail sector is about 8 x 10^9 ekWh per annum, out of a total consumption of 33 x 10^9 ekWh per annum, based on a careful estimate of the floor area devoted to retail stores across Canada. With the implementation of medium cost energy conservation measures, the retail potential for conservation is about 14 x 10^9 ekWh per annum.

* * *

De nombreuses chaînes canadiennes de magasins ont déjà commencé à mettre en oeuvre des mesures d'économies d'énergie de faible coût. Grâce uniquement à ces mesures, les économies d'énergie possibles pour l'ensemble du secteur de la vente au détail sont d'environ 8 x 10^9 ekWh par année, sur une consommation annuelle total de 33 x 10^9 ekWh, consommation qui a été estimée à partir de la surface de vente disponible dans tout le Canada. La mise en oeuvre de mesures d'économies d'énergie de coût moyen permettrait des économies d'énergies possibles d'environ 14 x 10^9 ekWh par année.

Le lecteur trouvera un sommaire en français de ce rapport à la page ii.

TABLE OF CONTENTS

PREFACE	i
SOMMAIRE	ii
1.0 INTRODUCTION	1
2.0 DEFINITION OF RETAIL TRADE	2
3.0 METHODOLOGY	5
4.0 DATA AVAILABILITY AND RELIABILITY	9
5.0 RETAIL FLOOR SPACE	10
6.0 ENERGY CONSUMPTION AND CONSERVATION POTENTIAL FOR RETAIL ESTABLISHMENTS	16
7.0 CONCLUSIONS AND RECOMMENDATIONS	23
GLOSSARY OF TERMS	25
BIBLIOGRAPHY/REFERENCE	26
APPENDIX SECTIONS	

Substantive information was required for the study of energy conservation in the Canadian retail sector. This work constitutes a first effort in this direction through the establishment of basic data concerning energy consumption patterns and conservation potential for four principal types of retail stores: supermarkets, shopping centers, department stores and small stores. Whereas the work is basic in nature and will be subject to correction and refinement as the process of data collection and analysis is improved and as further information becomes available, it represents a useful starting point for analysis in this area. A number of case histories of energy conservation in the retail sector are also presented by way of illustration.

Le présent travail a permis d'établir des données de base sur les modes de consommation d'énergie et sur les économies d'énergie possibles pour quatre grands types de magasins de détail: les supermarchés, les centres commerciaux, les grands magasins et les petits commerces. Il présente aussi des programmes types d'économies d'énergie menés dans les divers types de magasins.

La surface de vente total a servie de base à la définition de la consommation puisqu'il existe un lien direct entre cette surface de vente et l'énergie consommée. La surface de vente a été déterminée par division du chiffre d'affaires annuel par des coefficients de ventes au pied carré. Les estimations obtenues de cette façon ont été comparées à des données connues pour des commerces de la région d'Ottawa. La surface de vente ainsi calculée a ensuite été morecelée en fonction de groupes de magasins de consommation d'énergie comparable de même qu'en fonction de groupes de magasins de consommation d'énergie comparable de même qu'en fonction des types d'immeubles occupées. Puisque les coefficients de consommation par unit. de surface pour les divers types d'immeubles étaient connus, il .tait donc possible d'obtenir la consommation d'énergie pour chaque type d'immeuble et pour chaque groupe de magasins par simple multiplication de la surface de vente pour chaque type d'immeuble par le coefficient appropriée. De façon semblable, des coefficients par unité de surface ont servi à évaluer le possibilités d'économies d'énergie.

Le présent travail et d'autres sources ont permis d'établir que la consommation d'énergie annuelle du secteur canadien de la vente au détail était de $33,1 \times 10^9$ ekWh et qu'elle se répartissait de la façon suivante:

Centres commerciaux - 28,6%
Grands magasins - 5,6%
Supermarchés - 41,6%
Petits commerces - 24,2%

Les économies annuelles possibles ont été estimées à environ $9,7 \times 10^9$ ekWh, leur répartition étant la suivante:

Centres commerciaux - 48,7%
Grands magasins - 8.6%
Supermarchés - 24,3%
Petits commerces - 18,5%

Enfin, il est recommandé un certain nombre de mesures efficaces permettant d'économiser de l'énergie.

1. Centres commerciaux et grands magasins: réduire l'éclairage.

2. Centres commerciaux chauffés au mazout: améliorer le rendement des groupes en toiture.

3. Supermarchés: réduire l'éclairage et l'arrivée d'air frais.

4. Petits commerces: améliorer le rendement des groupes en toiture.

Le présent travail a permis d'entreprendre le morcellement du secteur de la vente au détail en groupes commodes facilitant l'analuse de la consommation de l'énergie, et il a ainsi permis d'établir des modes préliminaires de consommation ainsi que d'évaluer les économies possibles. Il est estimé que les économies d'énergie annuelles possibles dans le secteur de la vente au détail pourraient se chiffrer à plus de 200 000 000 $.

Les économies annuelles de 20 millions de dollars qui résulteraient du déploiement d'un très modeste effort (10 %) justifient amplement d'autres travaux dans le domaine. Il est par suite recommandé que l'on s'attaque notamment aux tâches qui suivent:

1. Rafinnement du morcellement du secteur de la vente au détail en groupes consommateurs d'énergie présentant des caractéristiques semblables.

2. Exécution d'autres études sur les modes de consommation et sur les économies possibles pour chacun de ces groupes.

3. Élaboration de statistiques sur chacun des facteurs de consommation (c'est-à-dire réfrigération, éclairage, chauffage et climatisation, etc.) pour faciliter la définition des priorités en matière d'économies d'énergie.

4. Élaboration de méthodes précises d'économies d'énergie et des instructions intéressant leur mise en oeuvre.

5. Sélection de véhicules appropriés pour transférer la technologies ainsi produite.

The objective of this study is twofold:

1) To establish the present energy consumption for retail stores subdivided by sector of the industry, by energy source and by building type.

2. To establish, for these sectors, potential energy savings resulting from existing conservation techniques.

The procedure followed was as follows:

a) identification of retail groups and store types;

b) estimation of total floor space;

c) apportionment of floor space by retail group;

d) distribution of groups among building types where necessary;

e) assignment of consumption rate by store group;

f) determination of consumption for each store group;

g) application of conservation coefficients by store group;

h) determination of conservation potential by store group.

Retail trades are defined by Statistics Canada as "the aggregate sales made through retail locations (outlets)". The principal activity of such outlets (or stores) is "the sale of merchandise and related services to the general public, for household or personal consumption". Not included in this definition are sales made through door-to-door selling, automatic vending machines, newspapers or magazines sold directly by printers or publishers and sales made by book or record clubs. The only exception is the mail-order and catalogue sales activity of department store businesses, which have been classified in the "general merchandise store" category. Statistics Canada's definition of retail trade excludes: retail sales through ancillary units, e.g. warehouses, head offices, etc.; retail transactions between individuals and sales contractors whose major activity is not retailing.

Though Statistics Canada includes in its definition sales by:

Motor vehicle dealers;

Used car dealers;

Service stations;

Garages;

Automotive parts and accessories stores;

these categories are excluded from this study since sales per square foot coefficients used for converting sales to floor space were not made available for these kinds of businesses.

Retail trade is not to be confused with service trade which is often an integral component of shopping areas consisting of banks, finance companies, beauty shops, shoe repair shops, etc. Service trade is also excluded from this study on account of non-availability of sales per square foot coefficients.

The kinds of retail establishments included in this study are:

A. FOOD GROUP

Supermarkets

Meat, Poultry, fish stores

Speciality food stores

Delicatessens

Bakeries

Candy and nut stores

Health food

Doughnut shops

Ice cream parlors

B. MERCHANDISE GROUP

Department Stores

General merchandise stores (or discount department stores)

General stores (or jr. department stores)

Variety stores

Men's clothing stores

Women's clothing stores:

. Ladies specialty
. Ladies ready to wear
. Maternity
. Hosiery

Family clothing stores:

. Children's wear
. Family wear
. Unisex jeans

Speciality shoe stores:

. Ladies shoes
. Men and boys shoes
. Children shoes

Family shoe stores

Hardware stores

- Hardware
- Home improvements
- Paint and wall paper

Household furniture, appliance, T.V., radio

- Furniture
- Lamps
- Radio and Hi-Fi

Personal accessories stores

- Tobacco
- Cards and gifts
- Camera
- Luggage and leather
- Toy
- Hobby shops

All other stores

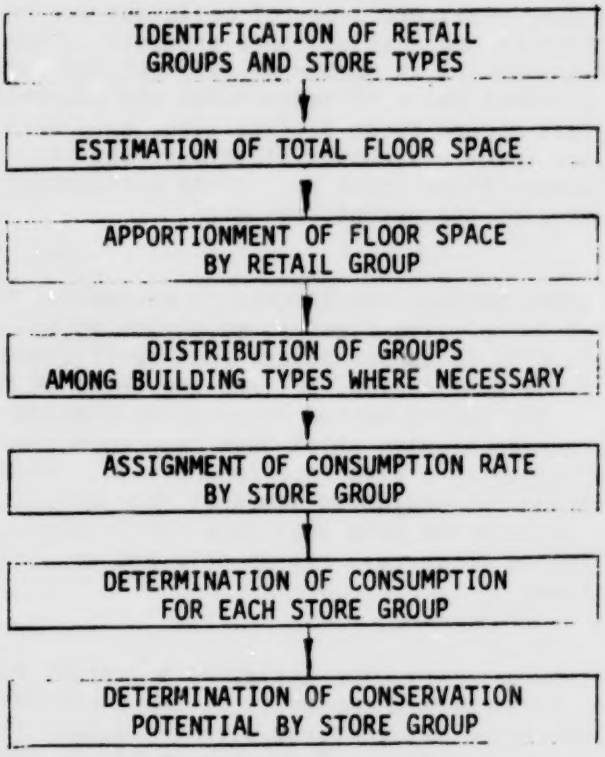
- Yard goods
- Curtains and drapes
- Imports
- Floor coverings
- China and glassware
- Arts and crafts
- Art gallery
- Candle shop
- Records and tapes
- Musical instruments
- Pet shops
- Sewing machines
- Key shops
- Liquor and wine

It is apparent that the retail sector is highly heterogeneous in nature. Retail outlets as a whole provide a wide variety of products. Consequently, diverse equipment is used and many sizes and types of buildings are required to house, maintain and display these products. From an energy analysis standpoint, a number of difficulties arise in arriving at a common basis of measurement and comparison. In order to get around these difficulties, an approach using total floor space was chosen since a direct relationship exists between floor space and energy consumption. Table 3.1 illustrates the methodology used.

Two different methods may be used in estimating total retail floor space. The first is to divide annual retail sales volume by sales per square foot coefficients contained in the publication "Dollars and Cents of Shopping Centres". The second method involves an examination of retail planning studies which have been conducted in a number of Canadian cities (see Appendix 1). Although the latter method is considered somewhat more accurate, it was not used because the data available in the present instance was limited to certain cities only and was collected at various times

As a procedural check, the estimates of retail floor space produced by the method chosen (i.e. the first method) for the Ottawa region was compared with the actual floor space inventoried by the Planning Department of the City of Ottawa and were found to be sufficiently accurate for the purposes of this study.

TABLE 3.1


IDENTIFICATION OF RETAIL GROUPS AND STORE TYPES
ESTIMATION OF TOTAL FLOOR SPACE
APPORTIONMENT OF FLOOR SPACE BY RETAIL GROUP
DISTRIBUTION OF GROUPS AMONG BUILDING TYPES WHERE NECESSARY
ASSIGNMENT OF CONSUMPTION RATE BY STORE GROUP
DETERMINATION OF CONSUMPTION FOR EACH STORE GROUP
DETERMINATION OF CONSERVATION POTENTIAL BY STORE GROUP

When the total floor space has been calculated, the retail sector is divided into groups of compatible store types, i.e. those with broadly similar energy consumption patterns. It should be noted that the store types comprising each group also have differences in their consumption patterns but further refinement was not carried out because the necessary data was unavailable.

Figure 3.1 shows the food and merchandising groups with their constituent store types. The retail sector was divided into these groups because the energy consumption patterns are different for food and merchandise stores since the food group requires additional energy for refrigeration and/or cooking. Each group is then subdivided into store types and a further distinction is made between chain

stores and independent stores. From an energy management viewpoint, this distinction is important for the following reasons:

1. Chain stores are usually located in Shopping Centres where a portion of the floor space and utilities are shared by the stores in the Centre. On the other hand, independent stores are less likely to share floor space and tend to have independent heating, cooling, ventilation and lighting systems.

2. Chain stores normally have a central managememt com-comprising fiscal, marketing and technical expertise which can effectively assess and implement viable energy conservation procedures. For this reason,and because of their greater financial resources, chain stores tend to be more active in the implementation of energy conservation measures than independent stores.

Finally, when the floor space has been apportioned into the groups, types and categories described above, it is further broken down by building type. This step is necessary because the required data with respect to energy consumption and conservation potential is available only in that form. The building types used for this purpose are:

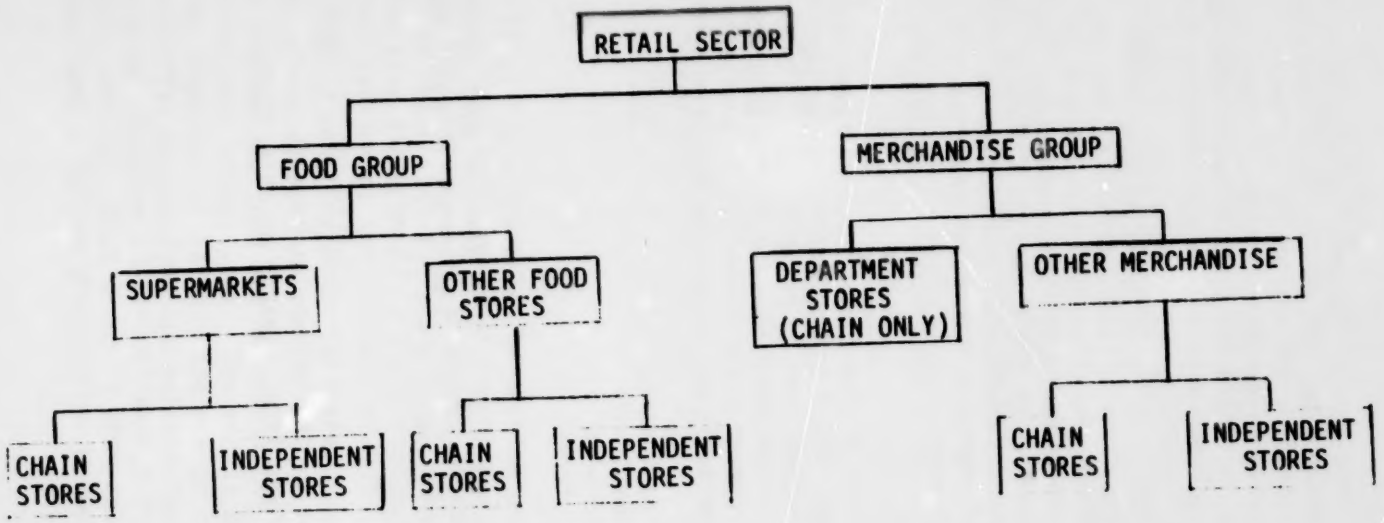
1. Shopping Centres
2. Department stores
3. Supermarkets
4. Small stores

Energy consumption is obtained for each building type by multiplying its floor area by the relevant energy performance coefficient.

Conservation potential is established by multiplying the floor area by the appropriate energy saving coefficient as determined from research on case studies.

FIGURE 3.1

STORE GROUPS AND CONSTITUENT STORE TYPES



It was found that statistics on floor space of Canadian retail establishments are not readily available in a compatible form for the entire retail sector. This conclusion is supported by a Royal Commission Report on Corporate Concentration by Ira Gluskin, Cadillac Fairview Corporation Ltd. (Jan. 1976) and by a more recent study (September 1981) by Canadian Resourcecon Ltd. for the Canadian Electrical Association. The study by Canadian Resourcecon Ltd. also recommends the amount of data acquisition which would be required to produce effective information relating to the various store types.

Reservations with respect to accuracy must prevail where data provided by Statistics Canada and sales per square foot coefficients produced by the Urban Land Institute (ULI)* relating to certain sectors is applied in this study to the country as a whole. The sales per square foot coefficients are given by ULI in "Dollars and Cents of Shopping Centres" for regional, community and neighborhood type Shopping Centres but, since data is unavailable concerning the distribution of these types in Canada, a hypothetical distribution was assumed. The distribution selected was used after it had been compared with actual Shopping Centre type distributions in Toronto, Ottawa-Hull and Gatineau regions.

Sales per square foot coefficients do not exist for independent stores. It was, therefore, assumed that the coefficients associated with Shopping Centres are relevant to this store type as well.

One shortcoming in estimating total floor space using the method described previously is that sales per square foot are not constant through time. Variations in the order of 10% and more can be observed for the period 1979-1980. To minimize this problem, total retail floor space for 1981 was estimated using the method described in the following section.

*Note: ULI is the only comprehensive source providing sales per square foot coefficients by store type.

5.1 General Description

This section details the process of calculating the total retail floor space by store type and then by building type.

5.2 Retail Floor Space by Store Type

From data supplied by Statistics Canada, the total retail sales figures for 1975 were divided by sales per square foot coefficients to obtain retail floor space for 1975. To this figure was then added the area of retail store construction which had been built between 1975 and 1981. The latter data was derived from "Canadata" figures based upon new retail construction starts as recorded by actual building permits issued during that period. The total retail area as calculated from this source is considered reliable since the data from which it is derived is based on information relating to the entire population rather than on samples. The results of these calculations are shown in Table 5.1A (Appendix II) for retail chain stores and Table 5.2A (Appendix II) for independent stores.

Whereas the "Canadata"*statistics are more precise in terms of total floor area, they do not clearly differentiate between store types. It was therefore assumed that the listing including the "others" category consists mainly of independent stores, while the "shopping centre or plaza" category comprises mostly chain stores. Therefore, to obtain an estimate of floor space by store type, the global figure for "shopping centre or plaza" was redistributed among store types using the same proportions as those appearing in Table 5.1A of Appendix II. The result of this procedure is Table 5.3A (Appendix II) which shows the construction figures for retail chain stores from 1975 to 1981. Table 5.4A (Appendix II) shows the same data for independent stores during the same period.

The distribution of floor space among store groups and types for both chain and independent stores is shown in summary Table 5.1.

---

*Canadata Data Base for the Residential and Commercial sectors - Program POPSTUD.

TABLE 5.1

RETAIL FLOOR SPACE BY STORE TYPE (1981)

STORE GROUP - Store type	FLOOR SPACE 1000 sq. ft.	
FOOD STORES		
- Supermarkets		
. Chain	65,908	
. Independent	27,694	
. Sub total		93,602
- Other food (small stores)		
. Chain	6,204	
. Independent	31,511	
. Sub total		37,715
MERCHANDISE STORES		
- Department stores		
. Chain only	61,837	61,837
- Other merchandise		
. Chain	146,771	
. Independent	175,594	
. Sub total		322,365
GRAND TOTAL		515,519

Table 5.5 A (Appendix II) shows that the total retail floor space in 1981 was approximately 515,000,000 square feet. When this is divided into food and merchandise groups the following breakdown become apparent.

In the food store group, supermarkets comprise 71% and other food stores account for 29% of the total food store floor space. Chain food stores of all types accupy 55% of the total food store space while 45% is taken up by independent food stores. The total food store floor space comprises 25% of the total retail floor space.

Within the merchandise group, department stores account for 16% of the total merchandising floor space and is deemed to be entirely owned by chains. The remaining 84% of the total merchandising floor space is divided between chain stores (46%) and independent stores (54%). The total merchandising floor space comprises 75% of the total retail floor space.

5.3 CONVERSION OF FIGURES BY STORE TYPE TO FIGURES BY BUILDING TYPE

The available energy and conservation performance data applies to building types. Therefore, it was necessary to convert the foregoing floor space figures into their corresponding buiding types values so that the appropriate energy performance coefficients and conservation factors could be applied. The building types are: shopping centers, department stores, supermarkets and small stores.

No such redistribution was necessary for floor space figures of department stores and supermarkets since these store types correspond exactly to their respective building types.

The floor space figures of all other store types in Table 5.1 were allocated to shopping centers and to small stores according to the distribution between these determined from case studies of three representative Canadian locations, (Toronto, Ottawa-Hull and Gatineau). Table 5.2 outlines the distribution between shopping centers and small stores observed in these locations.

TABLE 5.2

DISTRIBUTION BY BUILDING TYPE

LOCATION REPRESENTATIVE POPULATION RANGE	SHOPPING CENTER	SMALL STORES
Toronto (large)	38%	62%
Ottawa-Hull (medium)	55%	45%
Gatineau (small)	83%	17%

* Small stores comprise all stores which are neither supermarkets nor department stores and which are located outside shopping centers.

In order to establish the distribution of shopping centers and small stores for the whole of Canada, the population of the country was divided into the three representative population ranges shown in Table 5.2. Then the distribution of retail stores between shopping centers and small stores, as given in each range, was weighted in accordance with the proportion which that range represented to the total population. The result of this procedure was the following distribution of retail floor space:

68% in shopping centers
32% in small stores

The total retail floor space of 515,000,000 square feet was then allocated between shopping centers and small stores according to the above distribution. In order to eliminate double counting, the surface area of department stores and supermarkets was subtracted from that of shopping centers. Table 5.3 illustrates the resulting distributing of floor space by building type.

TABLE 5.3

DISTRIBUTION OF FLOOR SPACE BY BUILDING TYPE

BUILDING TYPE	FLOOR SPACE
Shopping centers (excluding dept. stores and supermarkets)	195 114
Department stores	61 837
Supermarkets	93 602
Small Stores*	164 966
TOTAL	515 519

*As defined in Table 5.2

6.1 PROVENANCE AND USE OF DATA

The energy consumption coefficients employed in these calculations were supplied by Engineering Interface Ltd. They are considered to be quite reliable as they are based upon large samples and yielded congruent results when compared with similar studies (references 5, 21 and 22).

On the other hand, the energy conservation coefficients, also furnished by Engineering Interface Ltd., are based upon a limited sample of case histories. For this reason, when calculating the energy savings potential, two scenarios were used, one of which is very conservative.

6.2 Retail Energy Consumption

Annual energy consumption estimates by building type are obtained by multiplying the corresponding energy performance coefficients by the floor space figures estimated in the previous section.

6.2.1. Energy Consumption in Shopping Centers

Energy performance data for shopping centers was available for the following categories.

6.2.1.1 All electric shopping centers, where the landlord provides all utilities including tenant lighting. Large department stores and supermarkets located in shopping centers are not included since they are metered separately and are each considered under their own classification.

6.2.1.2 Fuel-heated shopping centers which have all tenant utilities included in the landlord's metering. This group is the same as the all-electric group except that heating is provided by fuel.

6.2.1.3 General Remarks

The energy performance data supplied by Engineering Interface Ltd. for shopping centers in Quebec, Ontario, Manitoba and Alberta, corresponded closely to results found by Vinto Engineering Ltd. for shopping centers in British Columbia and Alberta.

The overall pattern of energy consumption in shopping centers, without regard to individual differences in the manner of heating (electric, gas or oil), was found to comprise 85% electrical energy and 15% gas and oil. An energy performance coefficient of 48.6 ekWh/sq.ft. year was derived from an average of these results.

6.2.2 Energy Consumption in Department Stores

The majority of the department stores were "anchor" stores forming part of a mall or strip plaza. The exposed wall area is typically 80%.

As in the case of shopping centers and without regard to the individual manner of heating it was found that the overall pattern of energy consumption was 79% for electrical energy and 21% for gas and oil. To the average performance coefficient was calculated to be 30 ekWh/sq.ft./yr.

6.2.3 Energy Consumption in Supermarkets

The energy performance figures presented here are part of two reports prepared for NRC on "Utility Analysis of Fifteen Supermarkets" including Miracle Food Marts, Food City and Dominion Stores Ltd. It will be noted that the consumption of energy in supermarkets is greater than in other types of stores because refrigeration, case heating and other power requirements are not applicable to other stores. The average performance coefficient for all these supermarkets is 147 ekWh/sq.ft./yr subdivided into 29% fuel and 71% electricity.

6.2.3 Energy Consumption in Supermarkets

It should be noted that information received subsequent to this work indicates that the foregoing coefficient is actually representative of the higher end of the supermarket energy consumption range and that a value of 100 ekWh would be closer to the average.

6.2.4 Energy Consumption in Small Stores

The energy performance data for small stores is based on a sample of 114 small stores of which 80% are located in strip malls, usually contained between two common walls. Energy use for these stores is typically for heating, cooling, lighting and fanning. High lighting levels is a common characteristic but small stores generally do not have unusual loads such as coolers. HVAC is usually provided by rooftop units with gas as the primary fuel. The average energy performance coefficient for these small stores is 48.4 ekW/sq.ft/yr with 22% of the energy consumed as fuel and 78% as electrical power.

TABLE 6.1

6.2.4 FLOOR SPACE & ENERGY CONSUMPTION BY BUILDING TYPE

BUILDING TYPE	FLOOR Thousands sq.ft	ENERGY PERFORMANCE COEFFICIENT ekWh/sq.ft/yr	ENERGY CONSUMPTION ekWh/yr x 10^6
Shopping centers (exluding dept. stores and super-markets)	195 114	48.6	9483
Department stores	61 837	30.0	1855
Supermarkets	93 602	147	13760
Small stores	164 966	48.4	7985
TOTAL	515 519		33083

6.3 Retail Conservation Potential

Energy conservation potential was calculated by multiplying floor space figures by energy conservation coefficients which were derived from case histories. However, these results should be used with caution because the samples upon which they are based are limited. These values must also be considered somewhat optimistic in respect to potential because one can expect that some action may have already been taken, particularly where conservation is obviously required and can be undertaken at relatively low cost. For these reasons, two alternatives coefficients were developed which lead to conservation scenarios which may be applied as deemed most appropriate. The calculated results are shown in Table 6.2.

TABLE 6.2

RETAIL CONSERVATION POTENTIAL

Building Type	CASE HISTORIES ekWh/yr x 10^6 (coefficients as shown)*	ALTERNATIVE ENERGY SAVING SCENARIOS	
		Scenario 1 coeff: 10ekWh/sq.ft ekWh/yr x 10^6	Scenario 2 coeff: 15ekWh/sq.ft ekWh/yr x 10^6
Shopping Centers	4732 (24.25)	1951	2927
Department Stores	841 (13.6)	618	928
Supermarkets	2350 (25.1)	936	1404
Small Stores	1798 (10.9)	1650	2475
TOTAL	9721	5155	7734

* These energy saving coefficients are derived from the case histories in Appendix III.

The relative importance of different conservation measures can be established from these case studies. (Appendix III). It can be noted that for shopping centers and department stores the most effective measures are removal of lighting fixtures and of phantom tubes. In fuel heated shopping centers, the most important measure consists of modifying rooftop units providing an energy saving of 15.7 ekWh/sq.ft./ year.

In supermarkets, the most effective measure consists of reducing intake of outside air, thereby reducing heating loads. This provides an estimated saving of 12.4 ekWh/ sq.ft./yr. Lighting is another important saving area.

For small stores, the most important energy savings are due to modifications to rooftop units controlling heating, ventilation and air conditioning. The savings here are 9.2 ekWh/sq.ft./year. It should be noted as well, that lighting modifications provide considerable energy savings. However, it is partially counterbalanced by the increased heating load due to lighting reductions.

A summary of the values of energy consumption shown in Table 6.1 and the figure for conservation potential shown in Table 6.2 are represented graphically on the following page.

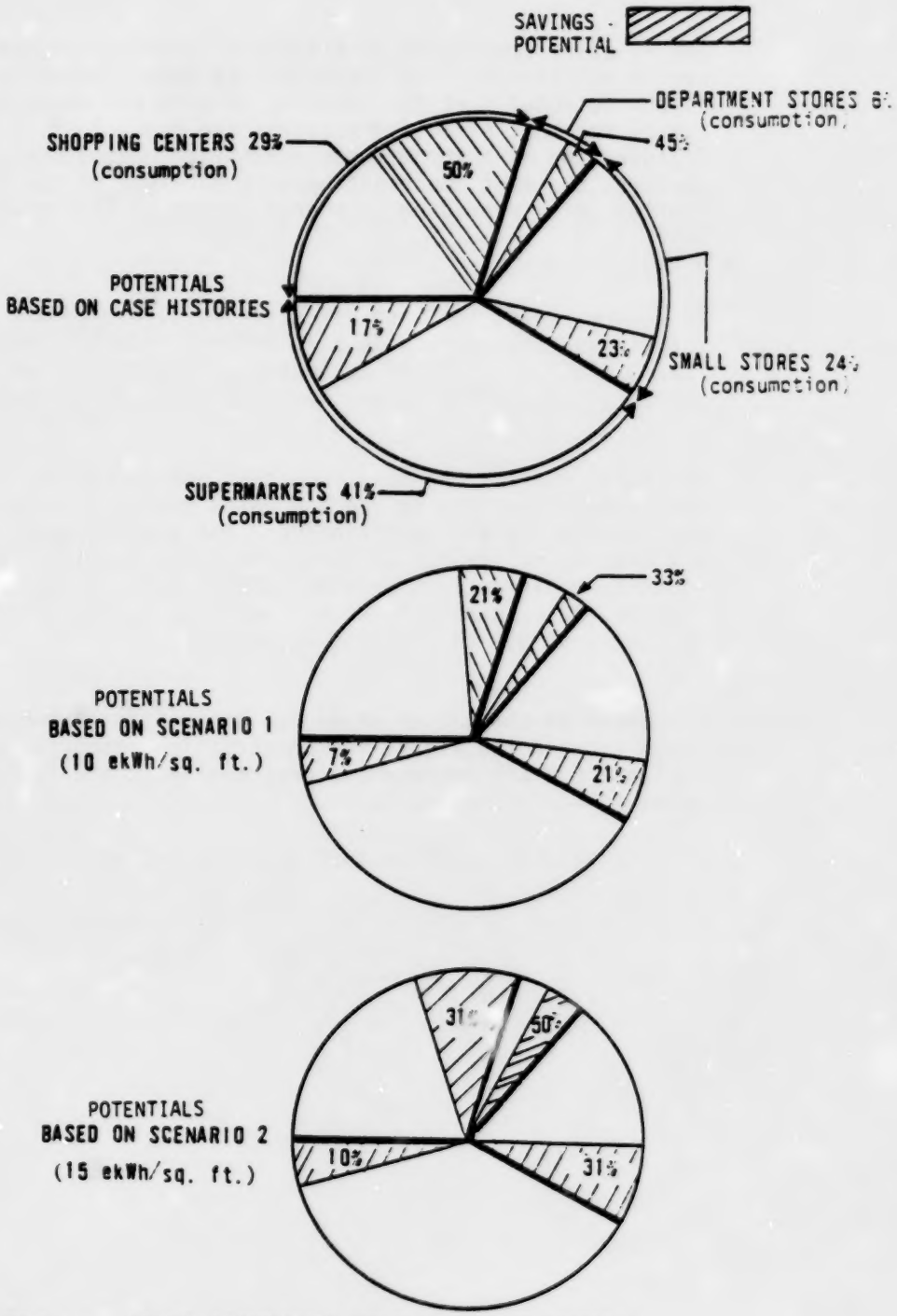


FIGURE 6.1 - ENERGY CONSUMPTION AND CONSERVATION DIAGRAMS

Assuming an average equivalent cost of power of $0.02/ ekWh and using the potentials shown in Scenario 2 of Table 6.2 it will be seen that the potential annual savings for the four building types are as shown in Table 6.3:

TABLE 6.3

POTENTIAL ANNUAL ENERGY SAVINGS *

Shopping Centers	58,540,000
Department Stores	18,560.000
Supermarkets	28,080,000
Small Stores	49,500,000
TOTAL	$154,680,000

From this it will be seen that shopping centers account for the largest single portion of the savings potential. Since many of them are owned by a few large corporation who have both the interest and the facilities to pursue the matter, this part of the retail sector represents a likely field for further investigation leading to specific remedial action.

The second largest piece of the potential pie is comprised of small stores. However, since this group of retailers are largely independent establishments with small premises and, since the numbers are large and the variety of funtion great, it's obvious that further study is required before this group can be dealt with effectively.

Supermarkets represent the third largest type but, since most of these stores belong to chains, since most are similar in nature and since they have the highest per unit area consumption of the four types, they offer a very promising area in which to begin conservation activities.

*These values are very conservative because of the low power cost used.

Department stores represent the smallest group but, since they comprise a relatively small number of stores which are largely controlled by a few large companies, conservation work can likely be implemented very effectively in this group as well.

This task has begun the work of breaking the retail sector down into convenient groups for energy analysis and has thence established preliminary consumption patterns and savings potentials.

As the energy savings potential and the equivalent energy cost used in Table 6.3 are both conservative, it will be seen that the annual savings could very likely exceed $200,000,000.

Since even a very modest (10%) beginning in the implementation of strategies to realize this potential will produce an annual savings of $20,000,000. it is quite apparent that further work in this area is justified. It is, therefore, recommended that the work be continued with emphasis on the following activities:

1. Refinement of the division of the retail sector into energy consuming groups with similar characteristics to aid analysis.

2. More extensive studies of the consumption patterns and conservation potentials to render this data more accurate.

3. Breakdown of individual consumption elements, e.g. refrigeration, lighting, heating and cooling, etc. to assist definition of conservation priorities.

4. Production of specific conservation procedures with appropriate instructions concerning their implementation.

5. Selection of appropriate vehicles to transfer the technology produced in 4. above.

1. Food group : Supermarkets ; grocery, confectionery and sundries stores ; and all other food stores.

2. Merchandise group : Department stores, general merchandise stores, general stores, variety stores ; men's clothing stores, women's clothing stores ; family clothing stores, speciality stores, hardware stores, furniture & appliances stores, and all other stores.

3. Chain stores : An organization operating four or more retail outlets in the same kind of business, under the same legal ownership.

4. Independent store : Any firm not meeting the above definition is automatically classified as an "independent" organization, the only exception being "department stores" which are classified in their entirety to the chain component.

5. Shopping center and plaza* : Consist of a group of stores sharing common space and utilities provided by one landlord. Though department stores and supermarkets are often part of shopping centers, they are examined separately as a result of their size.

6. Small stores : Are comprised mainly of independent store types. They are often individual buildings within strip shopping areas, contained between two walls. These stores do not share common spaces and utilities.

*Note : plaza is a loosely used term applied to strip shopping areas as well. In this study, it is used in the strictest sense to mean shopping centers, most often used when referring to neighborhood shopping centers.

1. Retailing, Challenge and Opportunity

Hartley, Robert F.
Houghton Mifflin Company, 1975
ISBN : 0-395-17073-7

2. Dollars and Cents of Shopping Centers

Urban land institute, 1975.

3. Les Economies d'énergie au Québec dans les secteurs industriel et commercial : potentiel et impact économique

Prepared by Cogesult Inc. for the Office of Energy Conservation, Quebec, 1-80.

4. Energy conservation in retail stores : review of Canadian and U.S. studies, surveys, programs and publication

EMR Publication #2b, 1979.

5. Patterns & Levels of Commercial and Industrial Energy Consumption : "A Case Study of Metropolitan Toronto"

Middleton Assoc. prepared for EMR
Building series #1, 1979.

6. Bibliography on Retail Energy Conservation in Canada

Engineering Interface Ltd, Feb. 1979.

7. Institutional Barriers to Energy Conservation in Existing Commercial Buildings

Hedlin Menzies Assoc. Consulting Economists & Planners, Oct. 1979

8. Study of Retail Stores in Gatineau & the Outaouais

Cogem Inc. - 420 Sherbrooke W., 1980.

9. Retail Study for the Town of Hull & Region

Larry Smith & Assoc., Oct. 1979.

10. Retail Study in Pontiac and Papineau County

INRS Urbanisation, 1979.

11. Statistics on Retail Establishments for Ottawa-Hull

Provided by the city of Ottawa, Dec. 1980.

12. The Energy Conservation Potential of the Building Sector and the Role of Research, Development and Demonstration in Realizing this Potential

Paper prepared by C. Ficner, S. Zaborowski & D.C. Hamilton, February 1980.

13. Mesures d'économie d'énergie dans les nouveaux bâtiments

CNRC no 16574 Comité Associé du Code National du Bâtiment, 1978.

14. Macro-Economic Impact and Other Considerations in Selecting Energy Conservation Measures

Jack Fawcett Assoc.Inc. prepared for U.S. Dept. of Commerce, June 1975.

15. Statistics Canada, Retail Trade Cat. # 63005-1980, 1975.

Census Data, Merchandising & Service Establishment Series.

Cat. #'s 97-701 to 97-707, 1971.

16. Design & Planning of Retail Systems

David Gosling & Barry Maitland
Whitney Library of Design : New York, 1977.

17. Urban Planning & Design Criteria 2nd Edition

J. Dechiara & L. Koppelman
Van Nostrand Reinhold Co. N.Y., 1975.

18. Rapport sur les données nécessaires aux évaluations énergétiques du secteur commercial

Prepared by Canadian Resourcecon for the Canadian Electrical Association, Sept. 81.

19. A Corporate Background Report for the Royal Commission on Corporate Concentration.

Ira Gluskin, Cadillac Fairview Corporation Ltd, Jan. 1976.

20. Le Commerce et La Distribution au Québec
Série 2.
Comité d'étude sur le fonctionnement et l'environnement du commerce au Québec (CEFECQ).
H. Marcel Caron & Cie, Juillet 1978.

21. Study on Energy Consumption of Retail Stores in Shopping Centers, in British Columbia

Vinto Engineering Ltd, Aug. 1981.

22. Study on Energy Consumption of Retail Stores in Shopping Centers in Alberta

Vinto Engineering Ltd.

23. Energy Consumption Data for Retail Sector

Engineering Interface Ltd. March 1980.

PLANNING AGENCIES

CATEGORIES INVENTORIED

FLOOR SPACE INVENTORIES BY MUNICIPALITIES

JURISDICTION	LAST INVENTORY	YEAR OF INVENTORY	SOURCES OF INVENTORY	RETAIL	OFFICE	SERVICE	WARE-HOUSE	EDUCA-TION	HEALTH
St-Jean (metrop.)	N.A								
Halifax (metrop.)	No								
Saint-Jean	N.A								
Chicoutimi	N.A								
Montréal (metrop.)	No								
Outaouais	N.A								
Ville de Québec (metrop.)	N.A								
Sherbrooke	N.A								
Durham (R.M.)	Yes	1981	Evaluation	Yes		Yes	Yes		
Halton (R.M.)	Yes	1979	Misc.	Yes	Yes	Yes	Yes	Yes	Yes
Hamilton-Wenthworth (R.M.)	No								
Bureau plan.Lakehead	No		Evaluation						
London	Yes	1980	Studies	Yes					
Niagara (R.M.)	No								
Ottawa-Carleton (R.M.)	N.A								
St-Catherines	Yes	1980	Evaluation	Yes	Yes	Yes			
Sudbury (R.M.)	Yes	1980	Evaluation, Studies	Yes	Yes	Yes	Yes	Yes	Yes
Toronto (city)	Yes	1981	Misc.	Yes	Yes	Yes	Yes	Yes	Yes
Toronto (metrop.)	Yes	1976	Misc.	Yes		Yes			
Waterloo (R.M.)	Yes	1980	Misc.	Yes					
Windsor	Yes	1980	Evaluation	Yes					
York)R.M.)	N.A								
Winnipeg	Yes	1980	Misc.	Yes					
Saskatoon	No								
Battle River (R.P.C)	No								
Calgary (city)	No								
Calgary (R.P.C)	N.A								
Edmonton	Yes	1980	Evaluation	Yes	Yes	Yes	Yes	Yes	Yes
Edmonton (R.P.C.)	Yes	1979	Evaluation	Yes		Yes			
Oldman River (R.P.C.)	Yes	1978-1980	Misc.	Yes	Yes		Yes		
Palliser (R.P.C.)	No								
Peace River (R.P.C.)	Yes	1979	Studies	Yes	Yes		Yes	Yes	
Red Deer (R.P.C.)	No								
South East Alberta (R.P.C.)	No								

Source : report prepared by Canadian Resourcecon for the Canadian Electrical Assoc. Sept 1981

PLANNING AGENCIES

CATEGORIES INVENTORIED

FLOOR SPACE INVENTORIES BY MUNICIPALITIES

JURISDICTION	LAST INVENTORY	YEAR OF INVENTORY	SOURCES OF INVENTORY	RETAIL	OFFICE	SERVICE	WARE-HOUSE	EDUCA-TION	HEALTH
St-Jean (metrop.)	N.A								
Halifax (metrop.)	No								
Saint-Jean	N.A								
Chicoutimi	N.A								
Montréal (metrop.)	No								
Outaouais	N.A								
Ville de Québec (metrop.)	N.A								
Sherbrooke	N.A								
Durham (R.M.)	Yes	1981	Evaluation	Yes		Yes	Yes		
Halton (R.M.)	Yes	1979	Misc.	Yes	Yes	Yes	Yes	Yes	Yes
Hamilton-Wenthworth (R.M.)	No								
Bureau plan.Lakehead	No		Evaluation						
London	Yes	1980	Studies	Yes					
Niagara (R.M.)	No								
Ottawa-Carleton (R.M.)	N.A								
St-Catherines	Yes	1980	Evaluation	Yes	Yes	Yes			
Sudbury (R.M.)	Yes	1980	Evaluation, Studies	Yes	Yes	Yes	Yes	Yes	Yes
Toronto (city)	Yes	1981	Misc.	Yes	Yes	Yes	Yes	Yes	Yes
Toronto (metrop.)	Yes	1976	Misc.	Yes		Yes			
Waterloo (R.M.)	Yes	1980	Misc.	Yes					
Windsor	Yes	1980	Evaluation	Yes					
York)R.M.)	N.A								
Winnipeg	Yes	1980	Misc.	Yes					
Saskatoon	No								
Battle River (R.P.C)	No								
Calgary (city)	No								
Calgary (R.P.C)	N.A								
Edmonton	Yes	1980	Evaluation	Yes	Yes	Yes	Yes	Yes	Yes
Edmonton (R.P.C.)	Yes	1979	Evaluation	Yes		Yes			
Oldman River (R.P.C.)	Yes	1978-1980	Misc.	Yes	Yes		Yes		
Palliser (R.P.C.)	No								
Peace River (R.P.C.)	Yes	1979	Studies	Yes	Yes		Yes	Yes	
Red Deer (R.P.C.)	No								
South East Alberta (R.P.C.)	No								

Source : report prepared by Canadian Resourcecon for the Canadian Electrical Assoc. Sept 1981

TABLE 5.1A ESTIMATED FLOOR SPACE FOR RETAIL CHAIN STORES (1975)

STORE GROUP Store type	SALES Million $	SALES/sq.ft. $/sq.ft.	FLOOR SPACE Million sq.ft.
Food stores			
. Supermarket	6 734.0	163	41.3
. Other food	462.5	118	3.9
Merchandise stores			
. Department stores	5 786.0	149*	38.8
. General merchandise	1 249.7	88*	14.2
. General stores	271.4	40	6.8
. Variety Stores	620.4	98	6.3
. Men's clothing	179.1	88	2.0
. Women's clothing	450.7	91	5.0
. Family clothing	320.0	105	3.0
. Speciality shoe	22.5	83	0.3
. Family shoe	243.8	67	3.6
. Hardware stores	90.7	63	1.4
. Furniture & appliances	850.0	108	3.2
. Drugs & cosmetics	333.5	94	3.5
. Books & stationary	87.9	65	1.4
. Florists	8.3	85	0.1
. Jewellery stores	182.7	139	1.3
. Sporting goods	20.6	86	0.2
. Personal accessories	165.8	113	1.5
. All other stores	3 173.1	93	38.2
TOTAL			176.0

* Obtained from Statistics Canada and used because these two coefficients are based on a larger sample size.

TABLE 5.2A ESTIMATED FLOOR SPACE FOR INDEPENDENT STORES (1975)

STORE GROUP . Store type	SALES Million $	SALES/sq.ft. $/sq.ft.	FLOOR SPACE Million sq.ft.
Food stores			
. Supermarkets	2 994.4	118	25.4
. Other food	2 690.1	93	28.9
Merchandise stores			
. General merchandise	348.5	60*	5.8
. General stores	724.1	40*	18.1
. Variety stores	198.5	31.5	6.3
. Men's clothing	484.4	93	5.2
. Women's clothing	412.0	87.2	4.7
. Family clothing	419.8	100.9	4.2
. Speciality shoe stores	26.4	78.8	0.3
. Family shoe stores	181.2	60.9	3.0
. Hardware stores	490.2	60.9	8.1
. Household stores	1 179.5	69.7	16.9
. Drugs & cosmetics	1 154.6	82.8	13.9
. Books & stationary	103.6	51.2	2.0
. Florists	162.3	82.4	2.0
. Jewellery stores	244.1	13.6	1.8
. Sporting goods	496.9	81	6.2
. Personal accessories	514.6	93.3	5.5
. All others	2 519.3	76.4	33.0
TOTAL			191.3

* Adjusted with respect to Statistics Canada estimate for chain stores.

TABLE 5.3A CANADATA NEW CONSTRUCTION (1975 to 1981) FOR RETAIL CHAIN STORES

STORE GROUP Store type	FLOOR SPACE Thousands sq.ft.
Food stores	
. Supermarket	24 608
. Other	2 304
Merchandise stores	
. Department stores	23 037
. General merchandise	8 482
. General store	4 084
. Variety stores	3 770
. Men's clothing	1 157
. Women's clothing	2 932
. Family clothing	1 780
. Speciality shoe	209
. Family shoe	2 094
. Hardware stores	838
. Household stores	1 885
. Drugs & cosmetics	2 094
. Books & stationary	838
. Florists	105
. Jewellery stores	733
. Sporting goods	105
. Personal accessories	942
. Others	22 723
TOTAL	104 720

Source: Canadata Data Base for the Residential and Commercial sectors - Program POPSTUD.

TABLE 5.4A CANADATA NEW CONSTRUCTION 1975 TO 1981 FOR INDEPENDENT STORES

STORE GROUP Store type	FLOOR SPACE Thousands sq.ft.
Food stores	
. Supermarket	2 294
. Other	2 611
Merchandise store	
. General merchandise	1 574
. General store	4 912
. Variety stores	53
. Men's clothing	46
. Women's clothing	26
. Family clothing	40
. Speciality shoe	634
. Family shoe	39
. Hardware stores	378
. Household store	1 082
. Drugs & cosmetics	330
. Books & stationary	65
. Florists	95
. Jewellery store	5
. Sporting goods	24
. Personal accessories	1
. Others	29 290
TOTAL	43 499

Source: Canadata Data Base for the Residential and Commercial sectors - Program POPSTUD.

TABLE 5.5A ESTIMATED FLOOR SPACE FOR RETAIL STORES 1981

STORE GROUP Store type	CHAIN Thousands sq.ft.	INDEPENDENT Thousands sq.ft.	
Food stores			
. Supermarket	65 908	27 694	
. Other food	6 204	31 511	
	(72 112)	(59 205)	
Merchandise stores			
. Department stores	61 837	---	
. General merchandise	22 682	7 374	
. General store	10 884	23 012	
. Variety store	10 070	6 353	
. Men's clothing	3 157	5 246	
. Women's clothing	7 932	4 726	
. Family clothing	4 780	4 240	
. Speciality shoe	509	934	
. Family shoe	5 694	3 039	
. Hardware stores	2 238	8 478	
. Furniture & appliances	5 085	17 982	
. Drugs & cosmetics	5 594	14 230	
. Books & stationary	2 238	2 065	
. Florists	205	2 095	
. Jewellery stores	2 033	1 805	
. Sporting goods	305	6 224	
. Personal accessories	2 442	5 501	
. All other stores	60 923	62 290	
	(208 608)	(175 594)	
TOTAL	280 720	234 799	515 519

APPENDIX 111

6.1A ENERGY SAVING CASE HISTORY, SHOPPING CENTER

CONSERVATION MEASURES	ENERGY SAVING COEFFICIENTS ekWh/sq.ft./yr	
	Fuel heated buildings	All-electric buildings
1. Lighting fixture removal and phantom tubes	7.8	7.8
2. Recircuiting lighting	0.6	0.6
3. Conversion from mercury vapour to high pressure sodium in parking lot lighting	3.0	3.0
4. Modifications to rooftop units	15.7	--
5. Economizer conversion	0.8	0.8
6. Micro-processor control	2.3	2.3
7. Fan slowdown	1.3	1.3
8. Rooftop unit sealing	1.2	--
TOTAL	32.7	15.8

Average 24.25 ekWh

This case history concerns the Fairview Park Mall in Kitchener Ontario. The figures shown were derived from results presented by Engineering Interface Ltd.

Based on the assumption that the floor space occupied by fuel heated buildings is equal to that of all electric buildings.

6.2A ENERGY SAVING CASE HISTORY, DEPARTMENT STORE

CONSERVATION MEASURES	ENERGY SAVING COEFFICIENT ekWh/sq.ft./yr
1. Lighting fixture removal and phantom tubes	7.8
2. Recircuiting lighting	0.6
3. Micro-processor	2.3
4. Economizer control	1.1
5. Rooftop unit sealing	1.3
6. Fan slowdown	0.5
TOTAL	13.6

The information presented above was derived from an energy saving case history for a department store in southern Ontario.

6.3A ESTIMATE OF ENERGY SAVING FOR SUPERMARKETS

CONSERVATION MEASURES	ENERGY SAVING COEFFICIENTS ekWh/sq.ft./yr
1. Reduction of heating load by decreasing outside air intake	12.4
2. Recircuiting lighting	0.6
3. Lighting fixture removal & phantom tubes	7.8
4. Economizer conversion	0.8
5. Micro-processor control	2.3
6. Rooftop unit sealing	1.2
TOTAL	25.1

The energy saving potential coefficients are estimated from information supplied by Engineering Interface Ltd. These estimates are based on typical savings due to lighting measures and on observations made by Engineering Interface Ltd.

6.4A ENERGY SAVING CASE HISTORY, SMALL STORES

CONSERVATION MEASURES	ENERGY SAVING COEFFICIENT ekWh/sq.ft./yr
1. Lighting modifications (Low watt lamps, micro-processor control)	5.5
2. Rooftop units	5.1
3. Micro-processor control	1.5
4. Increased heating load due to lighting reductions	5.3
5. Further modifications to rooftop units	4.1
TOTAL	10.9

The energy saving case history for small stores is based on a 12,000 sq.ft. drug store located in North York. The building is heated and cooled by air from two rooftop units. Heating in both rooftop units is by gas. Since the relative energy consumption was high in this case, the coefficient must be considered as optimistic.

APPENDIX IV

ENERGY CONSUMPTION DATA FOR RETAIL SECTOR

INTRODUCTION:

This report includes energy use data for Shopping Centres, Supermarkets, Department Stores and Small Stores.

Except for small stores, the data is divided into the nine SUMAC components used by Engineering Interface. Refer to the enclosed Introduction to SUMAC and SUMAC Terminology for definition of these components. It should be noted that components that are found to be weather sensitive are normalized to Toronto weather conditions. We do this for comparison of building energy use on a common basis. Weather normalization is done on a modified degree day basis rather than standard degree days. Modified degree days are the degree days for the balance temperature of the building which is often different from the Environment Canada degree day standard of 18°C.

The data can be considered representive for the retail sector with the following considerations:

- There is a large variety in energy intensity and operating hours for Shopping Centres.
- Supermarkets' data would not be representative of economy chains that do not carry fresh or frozen products.
- Small stores' data does not include any refrigeration for products.

SHOPPING CENTRES

SUMAC data for Shopping Centres is based on utility bills paid by the landlord.

Because of the diversity in energy services provided by shopping centre landlords, we have divided this data base into four groups, as follows:

1. All-Electric Shopping Centres

   For this group, the shopping centre landlord provides all utilities including tenant lighting. Major tenants such as large department stores or food stores are separately metered and not included in energy or area data.

2. Fuel Heated Shopping Centres

   These have all tenant utilities included in the landlord's metering. Group 2 is the same as Group 1 except heating is provided by fuel.

3. Fuel Heated Shopping Centres

   These have the landlord providing tenant heating but not lighting. Electrical covers common areas only. The majority of shopping centres are in this category, with some variations such as tenant cooling or fanning provided by the landlord.

4. Fuel Heated Shopping Centres

   These have the landlord covering services for the common area only.

In all cases, exterior lighting is included in the landlord's metering.

Note: Shopping Centres that have different areas for fuel and electricity -

The Grand Total is the simple addition of the fuel and electric totals per square foot. The Grand Total in these cases would reflect the typical energy use per square foot for the common area but not the tenant areas.

The owners of the shopping centres in the data base are Cadillac Fairview, Campeau Corporation, Trizec Equities Limited, and Columbia Commonwealth.

Figure 1

ALL ELECTRIC SHOPPING CENTRES

ALL SERVICES: COMMON AND TENANT AREAS (EXCLUDING MAJOR TENANTS)

kWh/ft.^{2}/yr.

REGION	ELECTRICITY (kWh/sf/yr.)					DEMAND PERFORMANCE (W/sf)					AREA (SQ.FT.)
	Base	Winter Extra	Summer Extra	Total Electric	Grand Total	Base Demand	Base Hrs/Wk	Winter Extra	Summer Extra	Total Demand	Electric
Quebec	20.70	5.50	2.00	28.20	28.20	*	*	*	*	*	161,600
Quebec	20.50	8.90	2.40	31.80	31.80	6.20	64	1.30	0.90	8.40	107,000
Quebec	21.00	9.70	2.00	32.70	32.70	6.85	58	0.53	0.00	7.38	102,500
Quebec	34.40	4.40	4.50	43.30	43.30	5.76	116	1.12	0.95	7.83	323,000
Southern Ontario	37.08	4.66	1.73	43.47	43.47	5.86	122	1.24	0.60	7.50	854,900
Average	26.74	6.63	2.53	35.90	35.90	6.17	90	1.05	0.59	7.81	

* information not available

Figure 2

FUEL HEATED SHOPPING CENTRES
ALL SERVICES: COMMON AND TENANT AREAS (EXCLUDING MAJOR TENANTS)
ekWh/ft.^{2}/yr.

REGION	FUEL PERFORMANCE (ekWh/sf/yr.)			ELECTRICITY (kWh/sf/yr.)					DEMAND PERFORMANCE (W/sf)					AREA (sf)	
	Non-Weather Sensitive	Weather Sensitive	Total Fuel	Base	Winter Extra	Summer Extra	Total Electric	Grand Total	Base Demand	Base Hrs/Wk	Winter Extra	Summer Extra	Total Demand	Fuel	Electric
Quebec	0.20	5.40	5.60	24.10	0.60	2.20	27.00	32.60	5.96	78	0.02	1.40	7.38	440,000	440,000
Manitoba	6.49	6.45	12.94	22.26	0.41	2.48	25.13	38.07	4.84	88	0.21	0.87	5.90	443,000	523,800
Alberta	14.63	6.28	20.91	34.83	3.63	3.62	42.08	62.99	6.41	104	0.22	0.00	6.43	563,200	563,200
Manitoba	8.47	15.67	24.14	37.65	4.60	8.88	51.13	75.27	9.49	76	0.57	1.56	11.62	180,000	220,000
Average	7.45	7.45	14.90	29.71	2.31	4.30	36.32	51.22	6.68	87	0.26	0.96	7.90		

Figure 3

FUEL HEATED SHOPPING CENTRES
TOTAL AREA HEATED (EXCEPT MAJOR TENANTS)
ELECTRICAL FOR COMMON AREA ONLY

ekWh/ft.^{2}/yr.

REGION	FUEL PERFORMANCE (ekWh/sf/yr.)			ELECTRICITY (kWh/sf/yr.)					DEMAND PERFORMANCE (W/sf)					AREA (sf)	
	Non-Weather Sensitive	Weather Sensitive	Total Fuel	Base	Winter Extra	Summer Extra	Total Electric	Grand Total	Base Demand	Base Hrs/Wk	Winter Extra	Summer Extra	Total Demand	Fuel	Electric
Quebec	0.20	3.20	3.40	13.70	0.80	3.10	17.60	21.00	3.75	70	0.01	0.93	5.52	984,000	138,000
Southern BC (strip mall)	3.20	14.30	17.50	13.37	0.74	0.02	14.13	31.63	*	*	*	*	*	65,000 (g)	7,000
Southern Ont	2.10	4.80	6.90	30.00	1.00	2.47	33.44	40.35	5.83	98	0.00	0.28	6.11	116,000	32,000
Southern Ont	2.40	9.70	12.10	16.20	1.60	5.20	23.00	35.10	3.67	85	0.12	1.41	5.20	71,000	50,000
Southern Ont	0.30	16.10	16.40	15.30	1.60	3.00	19.90	36.30	3.58	82	0.09	1.24	4.91	90,000	56,000
Saskatchewan	12.65	7.60	20.25	18.70	1.50	1.30	21.50	41.75	*	*	*	*	*	97,100 (g)	37,700
Southern Ont	6.80	8.10	15.00	19.80	1.80	5.30	27.00	42.00	3.48	110	0.04	0.91	4.43	140,000	65,000
Southern Ont	4.70	10.40	15.20	29.70	0.00	2.20	31.90	47.10	6.76	85	0.01	1.07	7.84	651,000 (+ AE)	100,000
Southern Ont	2.90	7.90	10.80	29.39	2.16	6.19	37.74	48.54	4.89	116	0.37	1.63	6.89	1,248,600	87,000
Southern Ont	0.10	12.60	12.70	40.80	1.00	3.40	45.20	57.80	9.15	86	0.12	0.54	9.81	200,000	74,000
Northern Ont	2.50	8.60	11.00	55.30	3.80	2.80	61.90	72.90	8.30	128	0.07	1.06	9.43	44,000	10,000
Average	3.44	9.39	12.83	25.66	1.45	3.18	30.29	43.12	5.49	96	0.09	1.00	6.58		

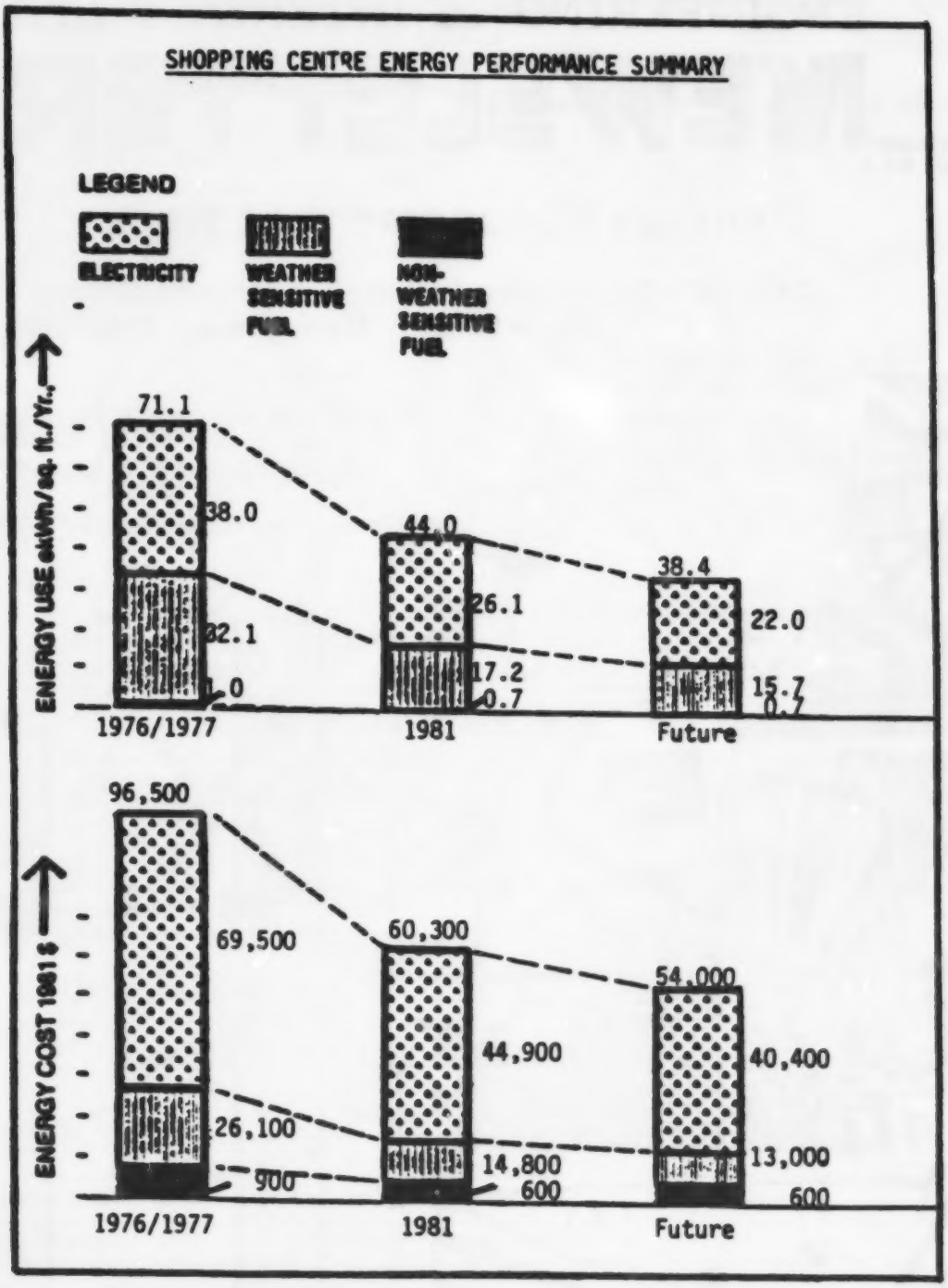
*Information not available

Figure 4

FUEL HEATED SHOPPING CENTRES
COMMON AREA SERVICES ONLY
$ekWh/ft.^2/yr.$

REGION	FUEL PERFORMANCE (ekWh/sf/yr.)			ELECTRICITY (kWh/sf/yr.)					DEMAND PERFORMANCE (W/sf)					AREA (sf)	
	Non-Weather Sensitive	Weather Sensitive	Total Fuel	Base	Winter Extra	Summer Extra	Total Electric	Grand Total	Base Demand	Base Hrs/Wk	Winter Extra	Summer Extra	Total Demand	Fuel	Electric
Southern Ont	0.10	7.40	7.50	13.50	0.40	5.00	18.90	26.40	*	*	*	*	*	60,000	60,000
Southern Ont	1.00	12.60	13.60	12.80	1.50	1.50	15.80	29.40	*	*	*	*	*	30,500	30,500
Southern Ont	1.30	10.80	12.10	20.30	1.40	1.70	23.50	35.50	3.58	109	0.09	1.31	4.98	97,000	97,000
Southern Ont	1.60	3.72	5.32	28.82	1.56	3.50	33.88	39.20	6.23	87	0.96	1.21	8.40	56,600	56,600
Northern Ont	5.80	26.00	31.80	22.00	0.00	2.90	24.90	56.70	*	*	*	*	*	78,000	78,000
Southern Ont	4.52	14.16	18.68	39.97	1.25	4.42	45.64	64.32	9.79	79	0.20	2.11	12.10	99,700	46,700
Average	2.39	12.45	14.84	22.90	1.02	3.17	27.09	41.93	6.56	92	0.42	1.54	8.52		

*Information not available


SHOPPING CENTRE ENERGY PERFORMANCE SUMMARY
LEGEND
ELECTRICITY
WEATHER SENSITIVE FUEL
NON-WEATHER SENSITIVE FUEL
ENERGY USE ekWh/sq. ft./Yr.
71.1
38.0
32.1
1.0
44.0
26.1
17.2
0.7
38.4
22.0
15.7
0.7
1976/1977
1981
Future
ENERGY COST 1981 $
96,500
69,500
26,100
900
60,300
44,900
14,800
600
54,000
40,400
13,000
600
1976/1977
1981
Future

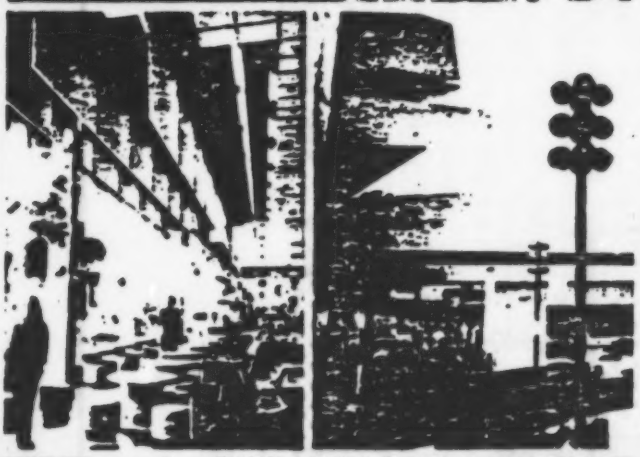
ENGINEERING INTERFACE LTD

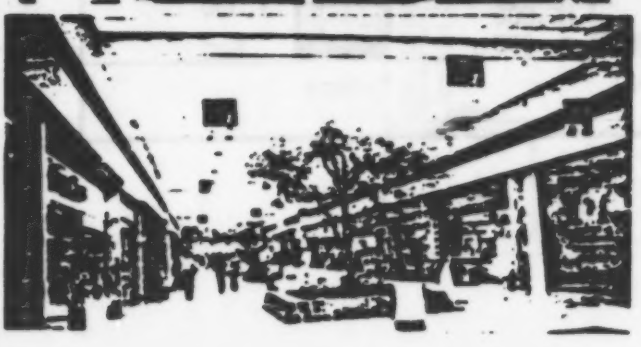
NEWSLETTER

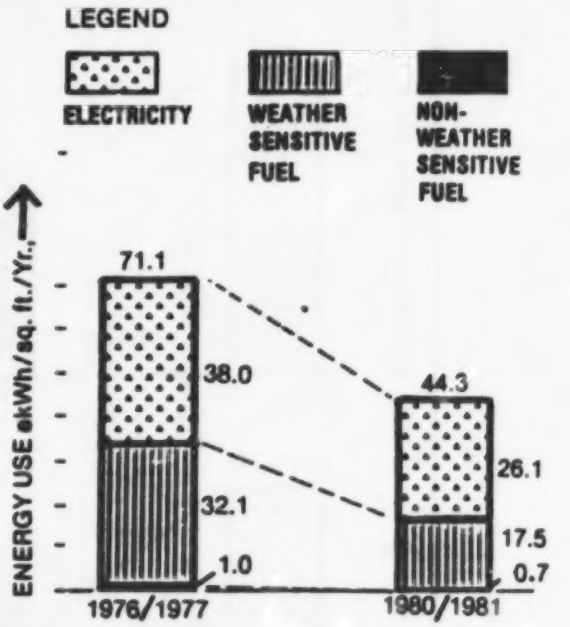
ISSUE NO. 2 NOV. 1981

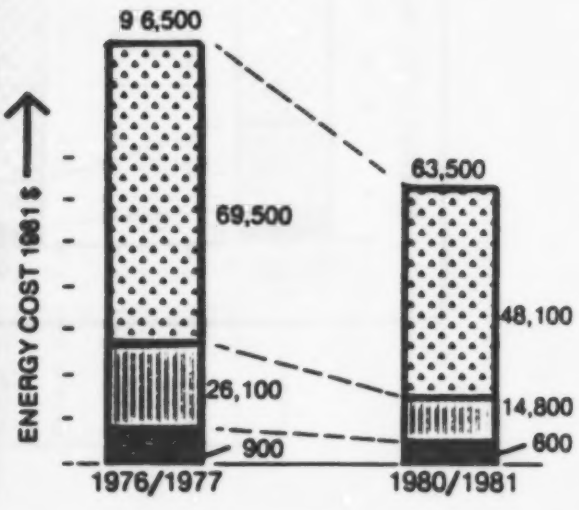
Energy Management At Work

CASE STUDY: Fairview Park Mall, Kitchener, Ontario
Stage I Energy Management Program









SAVINGS: $33,000 Per Year

TOTAL COST OF IMPLEMENTATION: $9,500

The Program

With some guidance from Engineering Interface and help from General Refrigeration, the service contractor, Cadillac Fairview's Bryce Ruhnke and his staff have been busy for several years testing and implementing low cost measures to save substantial energy dollars. Here are some of the changes they have made:

Electricity Savings....

- Lighting fixture removal
- Phantom tubes
- Seasonal operation of rooftop units
- Rooftop unit economizer control modification
- Conversion of manual dampers to economizer operation (pilot program)
- Recircuiting lighting
- Conversion from m.v. to h.p.s. parking lot lighting*

Gas Savings....

- Seasonal operation of rooftop units

Yet to Come

- Rooftop unit sealing
- Completion of economizer conversion program
- Fan slowdown
- Microprocessor control (to include individual stores)
- High efficiency night lighting ..... Watch For 1982/3 Update.

* Conversion to high pressure sodium accounted for two-thirds of the total cost, and served as a reinvestment program for energy dollar savings

How About You?

The work done at Fairview Park Mall may be repeated in whole or in part at other large stores and shopping malls. To see how you compare, get hold of your fuel and electricity bills for the past 12 months and fill in the spaces below.

BUILDING INFORMATION

	Fairview Pk Mall	Your Building		Fairview Pk Mall	Your building
Gross Area	* 57,400 sq. ft.		Energy Systems	Rooftop Htg. Clg.	
Age	1966			50% Economizers	
Location	Kitchener, Ontario			Mixed Lighting	
N°-of Entrances	9			Night Cleaning	
Outside Lighting	Parking Security				

1980/1981 ENERGY INFORMATION

	Fairview Park Mall		Your Building	
	TOTAL	Per sq. ft.	TOTAL	Per sq. ft.
Electricity — total kWhrs. from 12 bills	1,500,000	26.1		
Fuel — total gas from 12 bills*	3,560 MCF	62.0 C.F		

*For oil, multiply imperial gallons by 0.17

If you would like to know more about this program, or about application of some of these measures to your building, call:

Cadillac Fairview Corporation Limited,
Fairview Park Mall,
2960 Kingsway Drive,
Kitchener, Ontario. N2C 1X1
(519) 894-2450
Ask for Bryce Ruhnke

or

Engineering Interface Limited.
Suite 200, 2 Sheppard Ave. E.,
Willowdale, Ontario. M2N 5Y7
(416) 226-6565
Ask for Jim Rose, Vice President

SHOPPING CENTRE

ENERGY SAVING CASE HISTORY

What Was Done:

		Cost	Energy Savings	Annual Dollar Savings
1.	Lighting Fixture Removal and Phantom Tubes	Covered by maintenance budget	7.8 kWh/ft.^{2}/yr.	$15,990
2.	Modifications to Rooftop Units	"	15.7 kWh/ft.^{2}/yr.	$12,830
3.	Recircuiting Lighting	"	0.6 kWh/ft.^{2}/yr.	$ 1,230
4.	Conversion from Mercury Vapour to High Pressure Sodium Parking Lot Lighting	$6,500	3.0 kWh/ft.^{2}/yr.	$ 6,150
5.	Engineering and Contractor Services	$3,000		
		$9,500	27.1 kWh/ft.^{2}/yr.	$36,200

To Be Done:

		Cost	Energy Savings	Annual Dollar Savings
1.	Rooftop Unit Sealing	$1,000	1.2 ekWh/ft.^{2}/yr.	$ 1,450
2.	Economizer Conversion	2,000	0.8 kWh/ft.^{2}/yr.	$ 900
3.	Microprocessor Control	$30,000	2.3 kWh/ft.^{2}/yr.	$ 2,500
4.	Fan Slowdown	$ 500	1.3 ekWh/ft.^{2}/yr.	$ 1,450
		$33,500	5.6 ekWh/ft.^{2}/yr.	$ 6,300

DEPARTMENT STORES

The following characteristics are typical for the stores included in the listing:

- Majority of stores are "anchor" stores in malls or strip plazas.
- Exposed wall area is typically 80 percent.
- Sales area is typically 75 percent of total store area.
- Majority of stores use fluorescent lighting.
- Quebec stores have auto service areas.
- Most stores have economiser cooling capability.

FUEL HEATED DEPARTMENT STORES

	ENERGY PERFORMANCE EKWHR/SF/YR								DEMAND PERFORMANCE (WATTS/SQ.FT.)				
	FUEL			ELECTRICITY					BILLING DEMAND				
									Base		winter	summer	Tot
Store No.	NON-Weather Sensitive	Weather Sensitive	tot	Base	Winter Extra	Summer Extra	Tot	Grand Total	DMD.	(HRS/wk)	Extra	Extra	
1	.60	22.00	22.60	21.50	.80	3.30	25.60	48.20	4.43	(93)	.13	.68	5.24
2	3.40	19.70	23.10	16.10	1.40	1.30	18.80	41.90	3.88	(80)	.10	.44	4.42
3	8.00	8.70	16.70	19.50	.50	2.60	22.60	39.30	3.81	(78)	.05	.61	4.47
4	1.20	12.60	13.80	18.00	-1.30	1.30	18.00	31.80	4.00	(0)	0.00	0.00	4.00
5	.20	15.90	16.10	15.40	.30	1.10	16.80	32.90	3.55	(83)	.08	.96	4.59
6	1.60	9.90	11.50	18.00	.90	2.60	21.50	33.00	3.00	(115)	.06	.80	3.86
7	1.00	11.40	12.40	17.00	.30	1.90	19.20	31.60	4.18	(78)	.12	.82	5.12
8	1.30	12.40	13.70	15.10	.50	1.60	17.20	30.90	3.40	(85)	.01	1.19	4.60
9	.60	12.30	12.90	15.30	.30	1.30	16.90	29.80	3.18	(93)	.08	.46	3.72
10	1.00	13.40	14.40	14.00	.50	.60	15.10	29.50	3.58	(75)	.16	.79	4.53
11	.70	2.90	3.60	20.80	.90	3.40	25.10	28.70	3.65	(110)	.28	.88	4.81
12	1.50	12.80	14.30	11.80	.10	1.40	13.30	27.60	2.71	(84)	.03	.32	3.06
13	.50	9.20	9.70	13.30	0.00	2.70	16.00	25.70	2.73	(93)	.04	1.11	3.88
14	.80	6.20	7.00	15.05	.48	3.07	18.60	25.60	4.05	(72)	-.07	.70	4.68
15	.50	9.90	10.40	12.00	.10	1.60	13.70	24.10	2.84	(81)	.05	.61	3.50
16	.50	6.20	6.70	15.10	0.00	2.00	17.10	23.80	3.31	(88)	.06	.63	4.00
17	1.00	6.30	7.30	11.30	.70	2.60	14.60	21.90	2.94	(74)	.15	.85	3.94
AVERAGES	1.44	11.28	12.72	15.84	.38	2.02	18.24	30.96	3.48	(82)	.08	.70	4.26

ELECTRIC HEATED DEPARTMENT STORES

	ENERGY PERFORMANCE (EKUHR/SF/(YR)								DEMAND PERFORMANCE (WATTS/SQ.FT)			
	FUEL			ELECTRICITY					BILLING DEMAND			
									Base			
STORE NO.	Non-weather Sensitive	weather Sensitive	Tot	Base	WNTR Extra	SMMR Extra	tot	Grand Total	DMD. (HRS/WK)	WNTR Extra	SMMR Extra	tot
18	0.00	0.00	0.00	19.10	12.70	1.40	33.20	33.20	12.90 (0)	0.00	0.00	12.90
19	0.00	0.00	0.00	18.20	10.00	1.00	29.20	29.20	11.50 (0)	0.00	0.00	11.50
20	0.00	0.00	0.00	18.70	7.10	1.00	26.80	26.80	13.80 (0)	0.00	0.00	13.80
21	0.00	0.00	0.00	16.10	9.40	1.10	26.60	26.60	8.60 (0)	0.00	0.00	8.60
22	0.00	0.00	0.00	20.20	4.70	1.00	25.90	25.90	0.00 (0)	0.00	0.00	0.00
23	0.00	0.00	0.00	16.00	7.00	1.20	24.20	24.20	3.80 (81)	3.10	.80	7.70
24	0.00	0.00	0.00	13.90	5.80	1.00	20.70	20.70	4.00 (67)	3.30	2.10	9.40
AVERAGES	0.00	0.00	0.00	17.46	8.10	1.10	26.66	26.66	7.80 (21)	.91	.41	9.13

Store #	Region	Sales Area ($Ft.^2$)	HVAC
1	Southern Ontario	110,000	gas fired boiler, chiller
2	Quebec	100,000	oil fired boiler, chiller
3	Southern Ontario	101,500	rooftop units
4	Southern Ontario	109,000	gas fired boiler, chiller
5	Saskatchewan	147,800	rooftop units
6	Quebec	108,500	rooftop units
7	Southern Ontario	107,800	rooftop units
8	Saskatchewan	147,200	rooftop units
9	Ontario	108,500	rooftop units
10	Quebec	107,400	oil fired boiler, chiller
11	Southern Ontario	100,700	rooftop units
12	Nova Scotia	122,800	oil fired boilers
13	New Brunswick	111,900	rooftop units
14	Southern Ontario	110,600	rooftop units
15	Nova Scotia	111,500	rooftop units
16	Quebec	108,800	oil fired boiler
17	Quebec	120,400	oil fired boiler
18	Newfoundland	46,800	rooftop units
19	Newfoundland	46,800	rooftop units
20	Newfoundland	41,000	rooftop units
21	Newfoundland	48,000	rooftop units
22	New Brunswick	92,140	rooftop units
23	Quebec	92,100	rooftop units
24	Quebec	90,050	rooftop units

DEPARTMENT STORE

ENERGY SAVING CASE HISTORY

This store is a 108,500 square foot department store in southern Ontario. It is heated and cooled by air from 12 rooftop units equipped with economizers. Fuel consumption for this store is high compared to the retail average. The reduced wattage fluorescent lighting system in this store helps keep its annual electrical consumption well below the retail average of 22.3 kWh/ft.^{2}. The area of greatest potential for energy management was improvement in the operation of the rooftop units.

The Energy Performance Summary Diagram shows 1979 present and proposed use of gas and electricity. By measures which have already been taken, electricity use has been reduced by 2.3 kWh/ft.^{2}/yr. at a cost of $12,000. Gas consumption has been reduced by 1.1 ekWh/ft.^{2}/yr., all of it weather sensitive, at a cost of $50. Actions yet to be taken will bring consumption down further by 1.3 kWh/ft.^{2}/yr. electricity use and 2.7 ekWh/ft.^{2}/yr. in weather sensitive gas consumption. This should be achieved at a cost of $3,500.

What Was Done:

1. Installed microprocessor to control HVAC equipment operation.
2. Adjusted economizer controls to begin free outside air cooling at 60°F outside temperature.

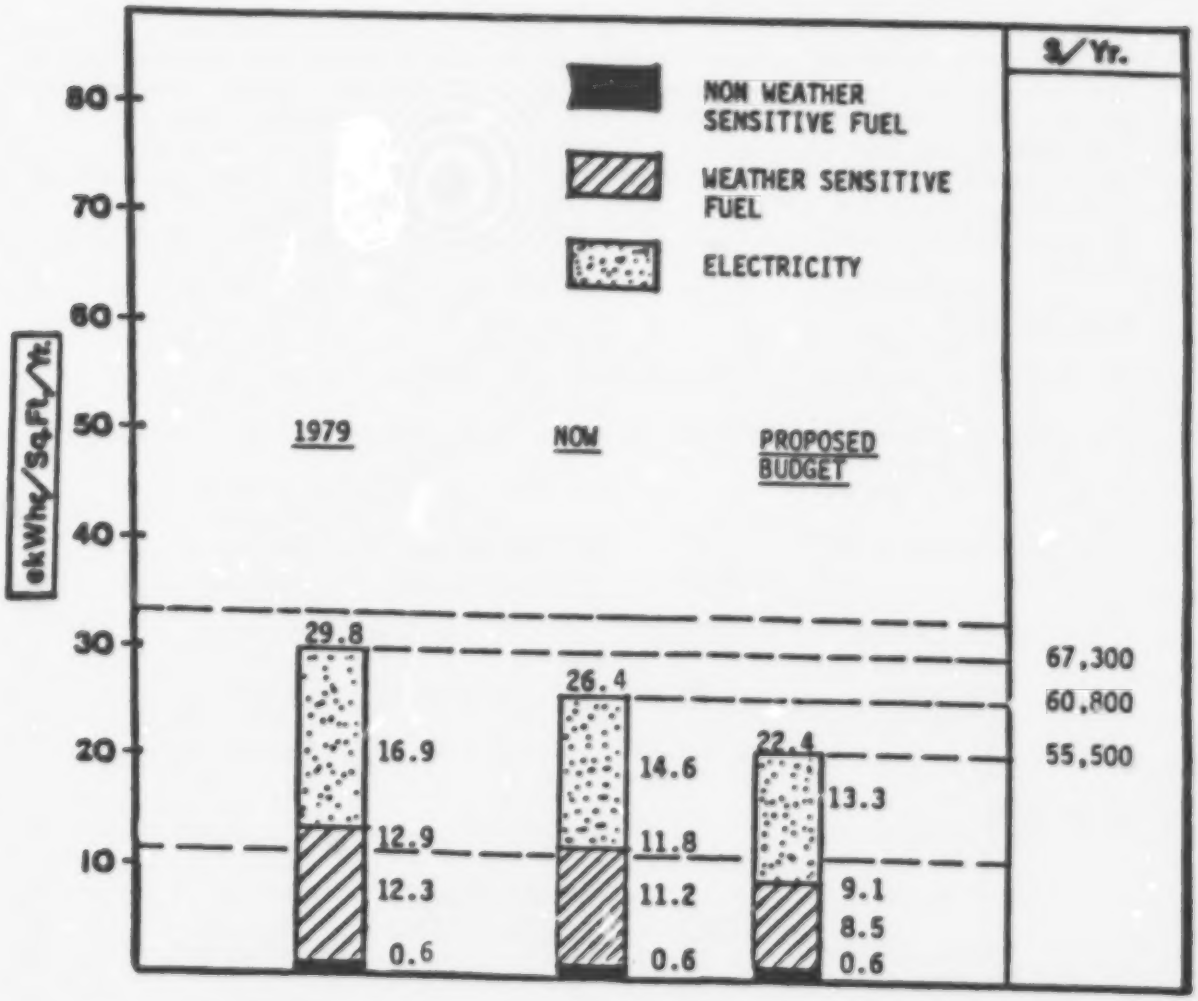
	Cost	Actual Annual Energy Savings	Annual Dollar Savings
1. Microprocessor	$12,000.00	250,000 kWh Elec.	$4,900.00
2. Economizer Controls	50.00	117,180 ekWh Gas	1,600.00
	$12,050.00	367,180 ekWh	$6,500.00

To Be Done:

	Cost	Actual Annual Energy Savings	Annual Dollar Savings
1. Rooftop Unit Sealing	$1,000.00	141,050 ekWh Gas	$1,500.00
2. Fan Slowdown	200.00	54,250 kWh + 21.7 kW	2,000.00
	$1,200.00	195,300 ekWh	$3,500.00

DEPARTMENT STORE

ENERGY PERFORMANCE SUMMARY



SUPERMARKETS

The enclosed supermarket energy performance figures form part of two reports for NRC on "Utility Analysis of Fifteen Supermarkets", copies of which have previously been forwarded to the Centre for Building Studies.

Included with the energy performance are tables detailing the building areas, systems and store schedules. Referring to the NRC reports should be helpful in analyzing this data and estimating the potential for energy conservation.

The supermarkets involved are Miracle Food Marts, Food City and Dominion Stores Ltd.

1979/1980 FUEL AND ELECTRICITY SUMAC UTILITY ANALYSIS

FOR FIFTEEN SUPERMARKETS

BUILDING ENERGY AUDIT

	ENERGY PERFORMANCE (EKWHR/S.F/YR)								DEMAND PERFORMANCE (WATTS/SQ.FT.)				
	FUEL			ELECTRICITY					BILLING DEMAND				
ID	non-weather sensitive	weather sensitive	Tot	Base	WNTR Extra	SMMR Extra	Tot	Grand Total	Base DMD.	Base (HRS/Week)	WNTR Extra	SMMR Extra	Tot
Group A													
Store No. 1	.2	102.4	102.6	119.6	1.5	3.9	125.0	227.7	17.2	(134)	.3	.8	18.3
Store No. 2	21.9	38.6	60.5	128.3	.6	4.9	133.8	194.3	16.9	(146)	.3	1.4	18.6
Store No. 3	27.7	37.2	64.9	80.7	-1.0	5.5	85.2	150.1	12.8	(121)	.1	2.0	14.9
Store No. 4	11.6	5.6	17.2	98.8	1.6	.2	100.6	117.8	16.0	(118)	.5	-.1	16.4
Store No. 5	2.3	27.9	30.2	68.6	.4	3.7	72.7	102.9	12.1	(109)	-.1	.8	12.8
Averages	12.8	42.3	55.1	99.2	.6	3.6	103.5	158.6	15.0	(126)	.2	1.0	16.2
Group B													
Store No. 1	8.4	51.3	59.7	81.7	6.4	7.9	96.0	155.7	11.9	(132)	.2	1.4	13.4
Store No. 2	12.0	43.9	55.9	84.5	.3	6.3	91.1	147.0	12.0	(135)	.1	2.1	14.2
Store No. 3	2.4	37.7	40.0	78.8	1.6	3.5	84.0	124.1	12.0	(127)	0.0	.7	12.7
Store No. 4	7.7	27.4	35.1	72.2	6.6	6.5	85.3	120.4	12.3	(113)	.2	.9	13.3
Store No. 5	3.4	26.5	29.9	59.0	2.8	7.0	68.7	98.6	10.0	(113)	.1	.8	11.0
Averages	6.8	37.4	44.1	75.2	3.6	6.2	85.0	129.2	11.7	(124)	.1	1.2	13.0
Group C													
Store No. 1	7.6	56.9	64.4	107.5	.1	6.2	113.8	178.2	15.2	(136)	.1	1.6	16.9
Store No. 2	13.1	.6	13.7	128.5	9.9	3.4	141.8	155.5	17.8	(139)	1.6	3.1	22.4
Store No. 3	14.1	42.3	56.4	88.2	3.4	6.1	97.7	154.1	13.7	(124)	.1	1.4	15.2
Store No. 4	0.0	0.0	0.0	121.2	16.7	5.0	142.9	142.9	16.2	(144)	2.7	1.2	20.1
Store No. 5	0.0	0.0	0.0	105.0	16.0	12.0	134.5	134.5	16.3	(125)	2.4	1.5	20.2
Averages	6.9	20.0	26.9	110.2	9.4	6.5	126.1	153.0	15.8	(134)	1.4	1.8	19.0

INSTALLED STORE LIGHTING LOADS

	LIGHTING Density W/ft²			LIGHTING TYPE			CONTROL		HOURS/WEEK @ 100%
	Total Lights / Sales Area	Sales Lighting / Sales Area	Lighting Total kW	HID	Incandescent	Fluorescent	Sales	Outside	
Group A									
Store No.1	4.2	2.8	95.5		✓	✓	Manual	Timeclock	125
2	4.2	3.6	74.4	✓		✓	Manual	Photocell	145
3	5.1	4.4	108.9		✓	✓	Manual	-	130
4	3.8	3.3	113.4	✓		✓	Microprocessor	Microprocessor	-
5	4.0	2.9	59.0		✓	✓	Manual	Manual	95
GROUP B									
Store No.1	4.6	3.8	73.8			✓	Timeclock	-	105
2	5.1	4.7	76.9		✓	✓	Timeclock	-	110
3	7.7	6.4	174.2			✓	Manual	-	85
4	3.4	2.4	65.9	✓		✓	Timeclock	Timeclock	110
5	2.7	2.3	59.6			✓	-	Photocell	115
GROUP C									
Store No.1	5.4	4.4	91.8		✓	✓	Timeclock	-	115
2	2.8	2.4	60.9	✓		✓	Continuous	Timeclock	168
3	4.3	3.7	64.7			✓	Manual	-	135
4	2.8	2.5	52.7	✓		✓	Manual	Timeclock	130
5	3.1	2.8	69.2	✓		✓	Manual	-	150

GAS HEATED STORES INCLUDED IN E.I.L. STUDY*

STORE	PERCENTAGE BREAKDOWN OF TOTAL ENERGY USE				TOTAL ENERGY USE ekWh/sq.ft./year
	Heat	Cases	Lights	Other	
GROUP A					
Store No. 1	41	36	10	13	212.7
2	25	28	11	36	179.3
3	37	34	25	4	135.1
5	29	47	18	6	102.9
GROUP B					
Store No. 1	32	33	15	20	140.7
2	31	36	19	14	132
3	23	31	25	21	109.1
4	19	25	16	40	105.4
5	30	36	19	15	98.6
GROUP C					
Store No. 1	36	30	12	22	178.2
3	37	28	19	16	154.1

*See Figure No. 1 for highest, average & lowest breakdown.

SCHEDULE OF STORE EQUIPMENT & OPERATION

	GROUP A Store No. 1 2 3 4 5	GROUP B Store No. 1 2 3 4 5	GROUP C Store No. 1 2 3 4 5
Exhaust Fan No.	8 4 7 2 0	8 7 5 8 3	5 4 2 6 1
Lights - Shut off	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓
Delamping Sales		✓	✓
Watt-Saving Type Lights	✓	✓	
Temperature Setback		✓ ✓ ✓ ✓	
Central System HVAC	✓ ✓ ✓		✓ ✓ ✓ ✓
Rooftop HVAC	✓ ✓	✓ ✓ ✓ ✓ ✓	✓ ✓
Cycling of Fans		✓ ✓ ✓ ✓	
Heat Reclaim HVAC	✓ ✓	✓ ✓	✓ ✓
Heat Reclaim DHW		✓ ✓ ✓ ✓	
Hussman New System Compressor Arrangement		✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓
Parallel Pack Arrangement	✓ ✓		
Individual Compressors	✓ ✓ ✓		✓
Organized Defrosts	✓ ✓	✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓
Hot Gas Defrosts 100%	✓ ✓	✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓
Refrigerant Sub-Cooling		✓ ✓	
Electric Heating	✓		✓ ✓ ✓
Gas Heating	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓	✓ ✓
Bakery	✓ ✓ ✓	✓ ✓ ✓ ✓	✓

SUPERMARKET ARCHITECTURAL DESIGN AND CONSTRUCTION

STORE NO.	OUTSIDE WINDOWS		OUTSIDE WALL	ROOF	DOORS TO OUTSIDE			GENERAL CONSTRUCTION		
	Area (ft^2)	Orientation	Area (ft^2)	Area (ft^2)	Overhead Doors	Single & Double Doors	Vestibules from Sales	Tight	Average	Loose
GROUP A										
1.	2,070	E	10,600	33,200	1	12	2			✓
	840	N								
2.	1,340	W	10,000	29,500	2	6	1		✓	
3.	1,920	W	10,900	32,400	0	7	4		✓	
4.	84	N	5,000	-	3	2	-	✓		
	126	W								
5.	920	S	9,000	28,500	0	7	2		✓	
GROUP B										
1.	1,070	N	11,600	25,300	2	2	1		✓	
2.	630	W	9,300	21,900	0	9	1		✓	
3.	1,500	S	13,200	34,900	2	1	2		✓	
	188	W								
4.	1,680	W	10,800	27,100	3	4	1		✓	
5.	1,200	S	11,700	31,200	2	3	1		✓	
GROUP C										
1.	2,550	W	9,800	26,900	2	4	2		✓	
2.	450*	S	12,500	33,100	2	4	2	✓		
3.	1,200	S	10,500	30,500	2	6	2		✓	
4.	500	N	9,100	27,500	2	5	2	✓		
5.	150	E	5,000	32,700	2	4	1	✓		

* Denotes double glass

STORE OPERATING HOURS

	STORE OPEN			RESTOCKING SCHEDULE
GROUP A				
Store No. 1	0900 - 2200 M-F	0800 - 1800 Sat.		2400 - 0800 Sun - Fri
2	0900 - 2200 M-F	0800 - 2200 Sat.		2200 - 0700 Mon - Sat
3	0900 - 2100 M-W	0900 - 2130 T,F.	0800 - 1800 Sat.	2300 - 0730; 2400 - 0800 Mon - Sat
4	0900 - 2200 M-F	0830 - 2200 Sat.		2400 - 0800 Sun - Fri
5	0900 - 2100 M-F	0900 - 2200 T,F,	0800 - 1800 Sat.	Day restocking
GROUP B				
Store No. 1	0900 - 2200 M-F	0800 - 2200 Sat		2200 - 0900 Twice weekly
2	0900 - 2200 M-Sat			2200 - 0800 M,T,W,F,
3	0900 - 2200 M-F	0800 - 2200 Sat.		2200 - 0800 M,T-F
4	0830 - 2200 M-F	0800 - 2200 Sat.		2100 - 0800 M, T,T,F,
5	0900 - 2200 M-F	0800 - 2200 Sat.		2200 - 0800 M, W,Th, F
GROUP C				
Store No. 1	0900 - 2100 M-W	0900 - 2200 T,F,	0800 - 1900 Sat.	2330 - 0800 M-F
2	0930 - 2200 M-F	0800 - 2000 Sat.		2400 - 0830 M-F
3	0900 - 2130 M,T	0900 - 2100 W,T,F,	0800 - 1800 Sat.	2400 - 0900 M-F
4	0900 - 2100 M-W	0900 - 2200 Th, F,	0800 - 1800 Sat.	2400 - 0830 M-F
5	0930 - 2130 M-F	0800 - 2000 Sat.		2400 - 0830 M-F

SMALL STORES:

Energy use data for 114 outlets of a major chain of speciality stores includes the following:

- store size in square feet
- total electrical consumption in kWh/sf/yr. normalized to Toronto weather conditions if found weather sensitive (i.e. electric heated stores)
- average hours per week operation for lighting and fans
- total fuel consumption in ekWh/sf/yr normalized to Toronto weather conditions
- total energy use in ekWh/sf/yr. (i.e. addition of fuel and electric energy performance).

All stores are located in Ontario with approximately 90 percent in Southern Ontario. Approximately 80 percent of these stores are located in strip malls or shopping centres, usually with a common wall on both sides.

Energy use for the stores is typically for heating, cooling, lighting and fanning. High light levels is a common characteristic. They do not have any unusual loads such as coolers. HVAC is usually provided by rooftop units with gas as the primary fuel.

SMALL STORES DATA BASE

	SIZE SF	ELECTRICITY CONS KWH/ SF/YR	ELECTRICITY DMD W/SF	ELECTRICITY HRS/ WK	FUEL CONS EKWH/ SF/YR	TOTAL ENERGY EKWH/ SF/YR
1	10,000	24.8	6.7	71	29.8	54.6
2	7,600	29.3	7.2	78	-	29.3
3	8,000	28.4	8.8	62	-	28.4
4	10,000	36.7	10.4	68	12.4	49.1
5	7,800	38.9	10.4	72	15.6	54.4
6	6,000	38.7	11.5	65	-	38.7
7	7,500	48.9	8.2	115	-	48.9
8	9,000	29.8	8.7	66	-	29.8
9	8,100	44.3	10.5	81	5.7	50.0
10	5,800	30.9	-	-	-	30.9
11	6,200	38.2	11.4	64	.6	38.8
12	6,160	23.2	10.6	42	-	23.2
13	3,200	40.3	10.0	78	18.4	58.7
14	7,200	31.4	-	-	8.8	40.2
15	3,400	51.7	11.3	88	11.2	62.9
16	6,060	32.1	7.8	79	-	32.1
17	7,400	31.0	8.2	73	13.0	44.0
18	5,360	27.6	6.7	79	9.4	37.0
19	7,744	30.2	8.5	68	20.1	50.3
20	6,600	43.0	10.1	82	11.5	54.5
21	2,800	54.8	17.6	60	-	54.8
22	4,700	32.1	10.2	61	21.0	53.1
23	7,500	41.1	10.9	73	-	41.1
24	13,200	33.3	6.8	94	9.7	43.0
25	5,000	45.5	-	-	19.4	64.9
26	16,000	24.6	4.6	103	-	24.6
27	7,200	30.7	7.6	78	3.8	34.7

	SIZE SF	ELECTRICITY CONS KWH/ SF/YR	ELECTRICITY DMD W/SF	ELECTRICITY HRS/ WK	FUEL CONS EKWH/ SF/YR/	TOTAL ENERGY SF/YR
28	7,000	42.3	8.9	91	10.5	52.8
29	4,000	43.9	15.4	55	7.4	51.3
30	5,580	41.8	9.8	82	10.8	52.6
31	8,000	33.1	7.7	83	13.2	46.3
32	6,700	44.3	11.0	77	1.2	45.5
33	4,200	51.9	13.8	72	18.8	70.7
34	7,200	38.2	9.1	81	15.1	53.3
35	6,200	34.2	8.4	78	2.1	36.3
36	2,400	51.8	-	-	-	51.8
37	6,000	33.6	7.9	82	5.8	39.4
38	6,900	33.3	10.4	62	13.7	47.0
39	6,000	32.8	5.1	124	33.3	66.1
40	12,500	36.8	8,2	86	5.5	42.3
41	5,000	53.7	12.5	83	23.3	77.0
42	7,632	38.6	-	-	30.5	69.1
43	5,500	26.9	14.0	37	4.9	31.8
44	4,200	26.5	7.6	67	-	26.5
45	7,500	28.5	9.9	55	-	28.5
46	3,536	32.2	12.1	51	-	32.2
47	7,003	45.6	14.6	60	10.0	55.6
48	5,000	34.3	10.9	61	6.2	40.5
49	10,500	35.7	8.9	77	2.3	38.0
50	7,200	49.1	10.4	91	8.8	57.9
51	7,800	27.4	6.9	76	11.3	38.7
52	7,900	41.0	11.2	70	6.6	47.6
53	5,915	38.5	9.9	75	9.8	48.3
54	6,700	41.9	8.9	91	15.6	37.5
55	5,750	48.1	9.4	98	3.8	51.9
56	5,500	42.2	10.1	80	25.0	67.2
57	6,000	56.1	11.0	98	9.1	65.2
58	7,800	35.2	8.0	85	-	35.2
59	6,900	45.4	10.5	83	3.9	49.3
60	7,200	28.6	8.5	65	9.9	38.5
61	6,000	37.3	-	-	18.9	56.2

	SIZE SF	ELECTRICITY CONS KWH/ SF/YR	ELECTRICITY DMD W/SF	ELECTRICITY HRS/ WK	FUEL CONS EKWH/ SF/YR/	TOTAL ENERGY SF/YR
62	8,000	30.2	9.0	65	13.6	43.8
63	6,600	42.5	-	-	2.9	45.4
64	5,500	43.4	11.2	56	-	43.4
65	3,080	63.2	16.0	76	-	63.2
66	2,480	55.3	-	-	-	55.3
67	7,000	71.7	9.7	142	-	71.7
68	5,000	50.1	12.0	80	-	50.1
69	10,000	36.9	9.3	76	22.8	59.7
70	5,900	64.3	12.2	101	12.8	77.1
71	4,600	46.6	11.3	79	-	46.6
72	13,000	45.8	12.4	71	32.8	78.6
73	6,300	53.6	10.5	115	8.7	62.3
74	7,700	62.6	11.3	107	18.9	81.5
75	3,800	51.7	10.2	97	-	51.7
76	6,700	37.7	7.1	102	-	37.7
77	4,618	57.5	11.4	97	8.1	65.6
78	6,500	45.1	11.6	75	-	45.1
79	4,750	47.6	11.5	80	-	47.6
80	9,328	47.6	9.2	99	10.8	58.4
81	4,500	43.5	10.4	80	17.4	60.9
82	3,000	21.1	4.5	90	-	21.1
83	7,500	30.1	7.6	76	-	30.1
84	6,380	52.6	12.3	82	-	52.6
85	2,800	53.3	-	-	12.9	66.2
86	3,800	54.3	13.1	80	-	54.3
87	12,000	30.7	6.6	89	12.6	43.3
88	5,372	53.9	15.0	69	1.2	55.1
89	6,800	24.5	6.0	79	-	24.5
90	6,952	42.2	8.7	93	-	42.2
91	2,345	43.7	8.8	95	-	43.7
92	10,000	33.2	7.2	89	24.6	57.8
93	5,700	50.5	10.6	92	24.6	75.1
94	5,800	46.5	11.7	76	22.7	69.2

	SIZE SF	ELECTRICITY CONS KWH/ SF/YR	ELECTRICITY DMD W/SF	ELECTRICITY HRS/ WK	FUEL CONS EKWH/ SF/YR/	TOTAL ENERGY SF/yr
95	8,800	21.9	-	-	-	21.9
96	8,500	36.7	7.6	93	-	36.7
97	4,500	37.4	10.4	69	-	37.4
98	5,304	45.0	11.6	75	9.3	54.3
99	4,500	45.2	-	-	17.9	63.1
100	4,200	26.2	-	-	-	26.2
101	6,500	40.2	12.4	62	20.6	60.8
102	4,420	20.1	-	-	-	20.1
103	5,500	31.3	6.9	87	-	31.3
104	6,331	45.6	10.7	82	8.1	53.7
105	7,000	30.1	10.7	54	4.9	35.0
106	6,000	47.8	11.1	83	1.8	49.6
107	5,962	37.3	10.8	66	1.4	38.7
108	5,240	33.7	8.3	78	6.0	39.7
109	4,400	32.7	7.2	87	13.7	46.4
110	6,000	34.4	8.1	82	-	34.4
111	5,300	41.6	-	-	3.2	44.8
112	4,100	36.4	11.5	61	-	36.4
113	3,000	70.0	16.0	84	23.5	93.5
114	6,700	34.7	9.0	74	38.6	73.3
	733,002	40.1	10.0	79	13.0	48.4
	TOTAL	AVR.	AVR.	AVR.	AVR.	AVR.

SMALL STORE

ENERGY SAVING CASE HISTORY

This 12,000 ft.^{2} drug store is located in North York. It is heated and cooled by air from two rooftop units. Heating in both rooftop units is by gas. Electricity consumption in this store was very high compared to the retail average. This is mainly due to the high light level maintained. The large reduction in lighting energy use achieved resulted in an increased consumption of gas for heating because of the reduction in internal heat gains.

What Was Done:

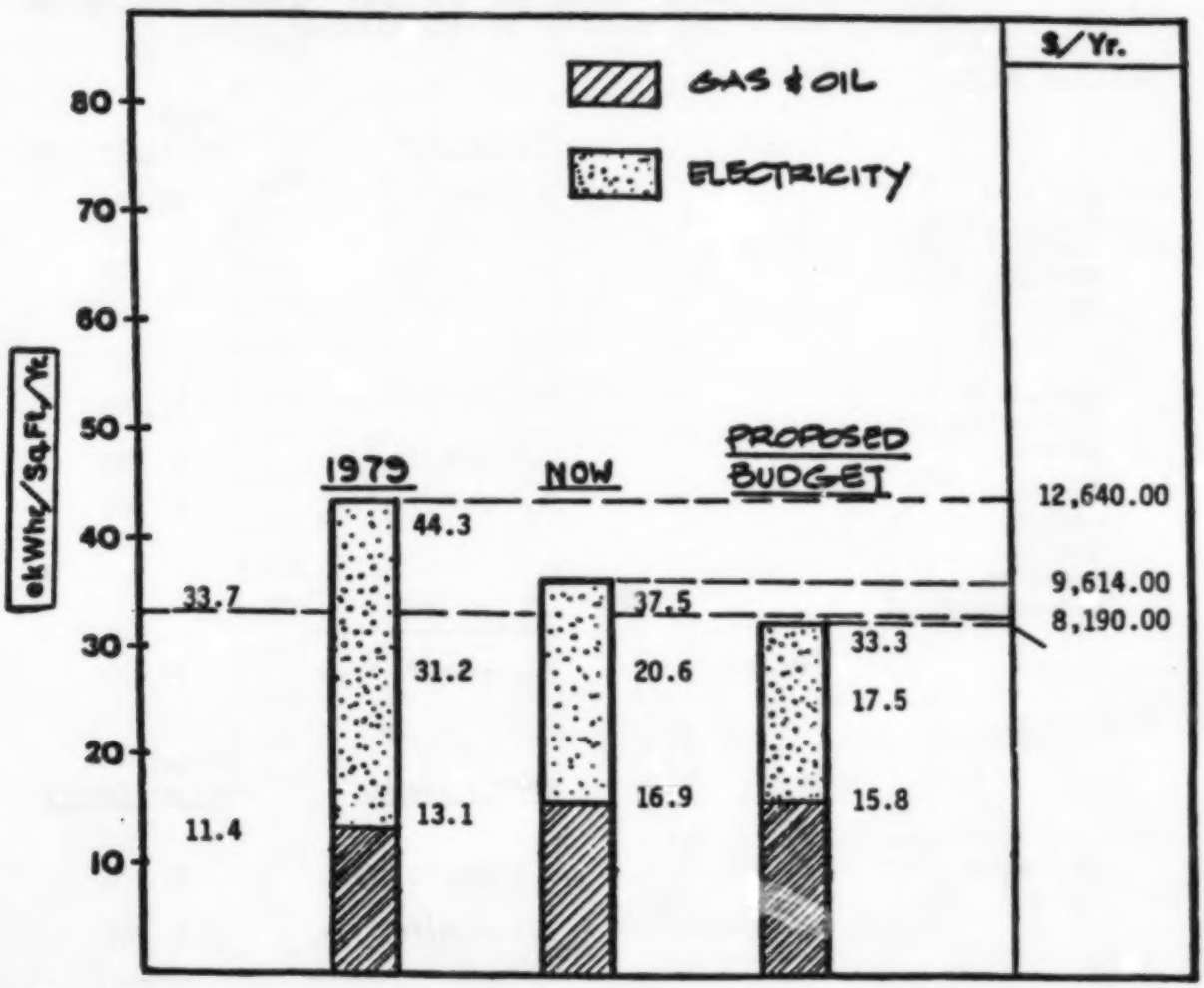
	Cost	Energy Savings	Annual Dollar Savings
1. Lighting Modifications		5.5 kWh/ft.^{2}/yr.	$1,800
Low Watt Lamps	$2,400		
Microprocessor Control	$7,000		
2. Rooftop Units Microprocessor Control		5.1 kWh/ft.^{2}/yr.	$1,700
		1.5 ekWh/ft.^{2}/yr.	$ 200
Increased Heating Load Due To Lighting Reductions		-5.3 ekWh/ft.^{2}/yr.	- $ 680
	$9,400	6.8 ekWh/ft.^{2}/yr.	$3,020

To Be Done:

	Cost	Energy Savings	Annual Dollar Savings
Further Changes To Rooftop Units	$ 500	3.1 kWh/ft.^{2}/yr.	$1,220
		1.1 ekWh/ft.^{2}/yr.	$ 200
		4.2 ekWh/ft.^{2}/yr.	$1,420

SMALL STORE

ENERGY PERFORMANCE SUMMARY



AN INTRODUCTION TO SUMAC

SUMAC* is a series of proprietary computer programs used to analyze energy use records from buildings. The SUMAC system was developed to allow meaningful energy evaluations to be conducted without time consuming and costly longhand audits.

The first task which SUMAC handles is to divide energy use into discrete components as indicated in Figure 1. Fuel is consumed for non-weather sensitive systems such as domestic hot water and kitchens, and for weather sensitive systems such as building and ventilation air heating. Electricity is used for systems which operate year round, such as lights, fans and equipment, for systems which operate only in winter, such as ramp heaters, and for systems which operate only in summer, such as chillers. Once these components are separated, their associated systems can be independently evaluated to more clearly see where energy management opportunities lie.

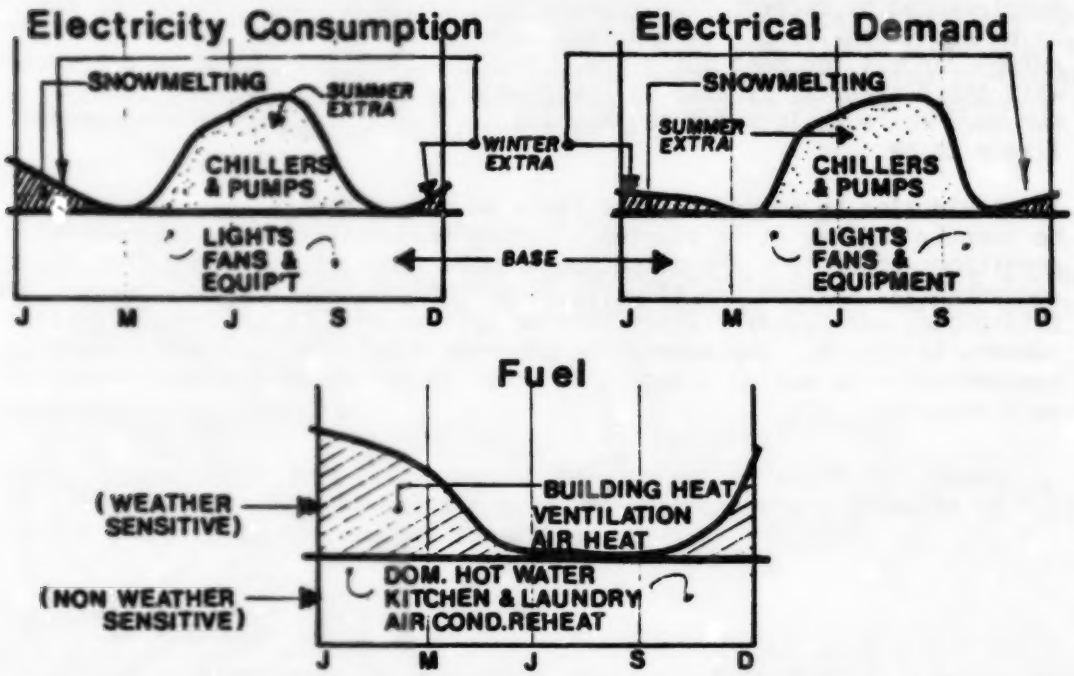


Fig. 1 SUMAC Energy Breakdowns

Other SUMAC analysis routines are dedicated to normalizing weather sensitive energy use. For precise analysis, conventional degree days were found

---

* System for Utility Monitoring, Analysis and Control. SUMAC is a registered trademark of Engineering Interface Ltd.

inadequate, and the program is now able to normalize each building's energy use, based on its own particular response to weather variations, still working simply from its energy use records. While energy use breakdowns shown in Figure 1 can often be generated longhand, accurate weather normalization is needed to separate electric heat in all-electric buildings and to cope with estimated gas bills or irregular fuel deliveries. Still more important, the response of fuel consumption to weather variations can reveal problems with boilers or heating controls, or even excessive infiltration. SUMAC's weather normalizing capability identifies these anomalies. Identification of the portion of energy use which is weather dependent allows energy performances of buildings in different geographic locations to be compared directly, which we believe to be a feature unique to SUMAC.

Having established how energy is used in a building, it is necessary to evaluate the various components. Several hundred buildings have been analyzed with SUMAC, and their results have served to set good, average and poor graduations on our energy yardsticks. These statistics are supplemented by records from submetering, by independent references and by extensive analysis. It has thus become possible to establish realistic energy targets for most buildings. The SUMAC analysis, read in conjunction with these targets, is able to direct energy programs, showing energy managers where to look for savings and how substantial those savings are likely to be.

It should also be noted that the route to budget energy levels may not be exactly the way it is charted. During implementation, actual operating conditions of systems are often found to be somewhat different from design, and potential savings are affected accordingly. Nevertheless, budgets are attainable, and lesser savings in some systems will be matched by greater success in others. Implementation programs should include measurement of systems prior to making changes, in order to verify cost effectiveness of each measure.

SUMAC

BUILDING ENERGY AUDIT

TERMINOLOGY

ENERGY PERFORMANCE (ekWh/sq.ft./year)

Total of all energy consumed during a twelve month period with fuel converted to the energy content standard of equivalent kilowatthours (ekWh). Total energy use is divided by the building area shown and normalized as follows:

a) from the actual number of days in the twelve month billing period to the standard year length of 365.25 days,

b) from actual heating season weather conditions prevailing for the location and period of analysis to conditions prevailing for a standard year at the location shown at the bottom of the energy AUDIT. Weather normalization is applied only to components found to be weather sensitive.

DEMAND PERFORMANCE (watts/sq.ft.)

Average electrical demand for the twelve month period of analysis divided by the building area and adjusted to standard heating season weather conditions if sensitive to weather.

NON-WEATHER SENSITIVE

Fuel usage which does not respond to changes in weather. Domestic water heating, kitchen cooking and air conditioning reheat are examples of fuel uses which are usually non-weather sensitive.

WEATHER SENSITIVE

Fuel usage which responds to weather changes. Such fuel is used to heat the perimeter of buildings and ventilation air. This weather sensitive component is adjusted to standard weather conditions.

BASE

Electric energy and demand for systems which are in use year round. This component may include lights, fans, elevators and other such electrical equipment.

WNTR EXTRA

Electric energy and demand during winter months which is in excess of the BASE. Electric heating or increased occupant use of electrical equipment during the winter are typical examples of winter extra components. If these components are found to be weather sensitive they are adjusted to standard heating season weather conditions.

SMMR EXTRA

Electric energy and demand during the summer months which is in excess of the BASE. Electric cooling is the primary use for this summer extra component. If the component is negative, less use of BASE electrical systems, such as lights and fans, is indicated. Such conditions are frequently found in schools and residential buildings which experience reduced occupancy during summer months.

BASE (HRS/WEEK)

Average operating hours per week for equipment included in the BASE component of demand such as lights and fans.

AVERAGE FOR THIS TYPE OF BUILDING

Average energy and demand performance for all buildings in the SUMAC data base with occupancy and design similar to this building. If information on building characteristics is unavailable, then no entries are made in this space.

PROPOSED BUDGET FOR THIS BUILDING

Energy and electrical demand budget within which this building should be able to operate. Conservation steps required to achieve this budget are detailed in a separate report. If data required for development of this budget is not provided, no entries are made in this space.

POOR

QUALITY

ORIGINAL